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Volatility and Dispersion in Business Growth Rates: Publicly Traded versus Privately Held Firms

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Abstract

We study the distribution of growth rates among establishments and firms in the U.S. private sector from 1976 onwards. To carry out our study, we exploit the recently developed Longitudinal Business Database (LBD), which contains annual observations on employment and payroll for all business establishments and firms. Our main finding is a large secular decline in the cross sectional dispersion of firm growth rates and in the average magnitude of firm level volatility. Measured in the same way as in other recent research, the employment-weighted mean volatility of firm growth rates in the private sector has declined by more than 40% since 1982. This result stands in sharp contrast to previous findings of rising volatility for publicly traded firms based on COMPUSTAT data. We confirm the rise in volatility among publicly traded firms using the LBD, but we show that its impact is overwhelmed by declining volatility among privately held firms. The rising activity share, higher volatility and increasingly volatile character of newly listed firms after 1979 explains much of the trend increase in volatility among publicly traded firms. We also show that business volatility and dispersion declined much more rapidly in Retail Trade and Services than in Manufacturing.

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I. Introduction

We study the distribution of annual growth rates among establishments and firms in the U.S. economy from 1976 onwards. To carry out our study, we exploit the recently developed Longitudinal Business Database (LBD) (Jarmin and Miranda, 2002), which contains annual observations on employment and payroll for all establishments and firms in the private sector. Compared to other longitudinal business databases for the United States, the LBD is unparalleled in its comprehensive coverage over an extended period of time. The underlying sources for the LBD are periodic business surveys conducted by the Census Bureau and federal government administrative data.[2]

Macroeconomists have increasingly recognized the potentially important interactions between aggregate economic performance and the volatility and heterogeneity of business-level outcomes. Idiosyncratic shocks are central to modern theories of unemployment. Frictions in product, factor and credit markets that impede business responses to idiosyncratic shocks can raise unemployment, lower productivity and depress investment. Financial innovations that facilitate better risk sharing can simultaneously encourage risk taking and investment, amplify business-level volatility, and promote growth. Several recent studies hypothesize a close connection between declining aggregate volatility and trend changes in business-level volatility. These examples of interactions between business-level and aggregate outcomes motivate our empirical study. Our central objective is to develop a robust set of facts about the magnitude and evolution of business-level volatility and the cross sectional dispersion of business growth rates in the U.S. economy.

Previous empirical work in this area yields an unclear picture. Several recent studies find a secular rise in average firm level volatility among publicly traded firms. Examples include Campbell et al. (2001), Chaney, Gabaix and Philippon (2002), Comin and Mulani (2003), and Comin and Philippon (2005). In Figure 1, we replicate a key finding from the latter two studies. The figure shows that the average magnitude of firm level volatility in the growth rates of sales and employment has roughly doubled since the early

[2] The LBD is confidential under Titles 13 & 26 U.S.C. Research access to the LBD can be granted to non-Census staff for approved projects. See www.ces.census.gov for more information. COMPUSTAT, which provides information on publicly traded firms only, has been the primary data source for recent work on firm level volatility.

1960s.[3] In a different line of research, Davis, Faberman and Haltiwanger (2005) and Faberman (2006) produce evidence of a downward trend in the excess job reallocation rate, a measure of cross sectional dispersion in establishment growth rates.[4] As seen in the top panel of Figure 2, the quarterly excess job reallocation rate in the U.S. manufacturing sector fell from about 12 percent in the early 1960s to 8 percent by 2005. The shorter time series in the lower panel shows a decline in excess job reallocation for the U.S. private sector from 16 percent or more in the early 1990s to less than 14 percent by 2005.[5] The data underlying Figure 2 are not restricted to publicly traded firms.

There is an unresolved tension between the evidence of rising firm level volatility and declining cross sectional dispersion in establishment growth rates. To appreciate the tension, consider a simple example in which all employers follow identical and independent autoregressive processes. Then an increase in the innovation variance of idiosyncratic shocks implies an increase in employer volatility *and* in the cross sectional dispersion of growth rates. Of course, it is possible to break the tight link between employer volatility and cross sectional dispersion in more complicated specifications. It is also possible that firm and establishment growth processes have evolved along sharply different paths in recent decades. Yet another possibility is that the restriction to publicly traded businesses in previous studies paints a misleading picture of firm level volatility trends in the economy as a whole.[6] A related possibility is that the economic process governing selection into the set of publicly traded firms has changed over time in ways that affect measured trends in volatility.

In what follows, we explore each of these issues. We find similar trends in cross sectional dispersion and firm level volatility, so the different measures cannot account for the contrast between Figures 1 and 2. Instead, the resolution turns mainly on the distinction between publicly traded and privately held businesses. For the private

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[3] Firm level volatility is calculated from COMPUSTAT data as a moving ten-year window on the standard deviation of firm level growth rates. See equation (5) in section III below.

[4] Excess job reallocation equals the sum of gross job creation and destruction less the absolute value of net employment growth. Dividing excess reallocation by the level of employment yields a rate. One can show that the excess reallocation rate is equivalent to the employment-weighted mean absolute deviation of establishment growth rates about zero. See Davis, Haltiwanger and Schuh (1996).

[5] Job flow statistics for the whole private sector are from the BLS Business Employment Dynamics. They are unavailable prior to 1990.

[6] Acemoglu (2005), Eberly (2005) and Davis, Faberman and Haltiwanger (2005) question whether sample selection colors the findings in previous studies of firm level volatility.

nonfarm sector as a whole, both firm level volatility and cross sectional dispersion measures show large declines in recent decades. The declines are even more pronounced among privately held businesses. For publicly traded firms, we provide independent evidence that cross sectional dispersion and firm level volatility have risen during the period covered by the LBD, but the rise is not big enough to offset the large decline among privately held firms.

Entry and exit play a major role in accounting for both the level and trend in dispersion and volatility among privately held firms and for the private sector as a whole. In particular, dispersion and volatility measures are much smaller in magnitude and decline less over time when we exclude entry and exit. In addition, we show that the patterns differ sharply across industries. For example, trend declines in volatility and dispersion are much stronger in Retail Trade and Services than in Manufacturing. Well-documented structural transformations in certain industries such as Retail Trade appear to explain much of the industry differences. We also investigate why the trends differ so dramatically between publicly traded and privately held firms. In this respect, selection and changing composition are critical. There was a large influx of newly listed firms after 1979, and newly listed firms are much more volatile than seasoned firms. Moreover, we find that firms newly listed in the 1980s and 1990s exhibit much greater volatility than firms in earlier cohorts even after controlling for age.

The paper proceeds as follows. Section II reviews the role of idiosyncratic shocks, producer heterogeneity and risk-taking in selected theories of growth, fluctuations and unemployment. Section II also identifies several factors that influence firm level volatility and its connection to aggregate volatility. Section III describes our data and measurement procedures. Section IV presents our main empirical findings on volatility and cross sectional dispersion in business outcomes. Section V explores various factors that help to explain and amplify our main findings. Section VI offers concluding remarks.

II. Conceptual Underpinnings

Theories of growth and fluctuations in the Schumpeterian mold envision a market economy constantly disturbed by technological and commercial innovations. Firms and workers differ in their capacities to create, adopt and respond to these innovations, so that winners and losers emerge as unavoidable by-products of economic progress. According to this view, an economy's long term growth rate depends on how well it facilitates and responds to the process of creative destruction (Aghion and Howitt, 1998). Institutions and policies that impede restructuring and adjustment can mute the disruptive nature of factor reallocation – at the cost of lower productivity, depressed investment and, in some circumstances, persistently high unemployment (Caballero, 2006).

Empirical evidence supports the Schumpeterian view in its broad outlines. Continuous, large-scale job reallocation is a pervasive feature of market economies (Davis and Haltiwanger, 1999). Large job flows and high firm level volatility reflect the restructuring, experimentation and adjustment processes at the heart of Schumpeterian theories. Empirically, gross job flows are dominated by reallocation within narrowly defined sectors, even in countries that undergo massive structural transformations. Thus longitudinal firm and establishment data are essential for helping gauge the pace of restructuring and reallocation. Empirical studies also find that excess job reallocation rates decline strongly during the early lifecycle of firms and establishments (Davis and Haltiwanger, 1992, and Bartelsman, Haltiwanger and Scarpetta, 2004). This finding indicates that experimentation and adjustment in the face of uncertainty about demand, technologies, costs and managerial ability are especially pronounced among younger businesses. Hence, we anticipate that firm level volatility and cross sectional dispersion in growth rates are greater for younger firms.

A closely related empirical literature highlights the role of factor reallocation in productivity growth. Over horizons of five or ten years, the reallocation of inputs and outputs from less to more productive business units typically accounts for 20-50 percent of industry-level productivity growth (Foster, Haltiwanger and Krizan, 2001). Several studies reviewed in Caballero (2006, chapter 2) provide evidence that trade barriers, entry barriers, impediments to labor mobility, and misdirected financing can hamper efficient factor reallocation and, as a result, retard restructuring and undermine productivity growth. In short, there are sound theoretical and empirical reasons to treat restructuring and factor reallocation as key aspects of growth and fluctuations. The business volatility and dispersion measures that we construct in this paper capture the pace of restructuring and reallocation on important dimensions. In this respect, they are useful inputs into theories of growth and fluctuations in the Schumpeterian mold.

Theories of unemployment based on search and matching frictions (Pissarides, 2000) rely on idiosyncratic shocks to drive job destruction and match dissolution. An increased intensity of idiosyncratic shocks in these models produces higher match dissolution rates and increased flows of workers into the unemployment pool. The measures of employer volatility and dispersion that we consider provide empirical indicators for the intensity of idiosyncratic shocks. Evidence regarding trends in these indicators can serve as useful inputs into quantitative theories of longer term movements in the rates of unemployment and match dissolution. These indicators also provide grist for empirical studies of how long term changes in idiosyncratic shock intensity affect unemployment. We do not investigate the connection between longer term movements in unemployment and employer volatility in this paper, but our measurement efforts are a step in that direction.

Another class of theories stresses the impact of risk-sharing opportunities on the willingness to undertake risky investments. Obstfeld (1994), for example, shows that better diversification opportunities induce a portfolio shift by investors toward riskier projects with higher expected returns. Easier diversification for portfolio investors also weakens one motive for organizing production activity around large, internally diversified firms. On both counts, improved diversification opportunities lead to more volatility and cross sectional dispersion in producer outcomes. Empirical indicators of better diversification opportunities include the rise of mutual funds and institutional investors, lower trading costs for financial securities, higher stock market participation rates and greater cross-border equity holdings. Motivated in part by these developments, Thesmar and Thoenig (2004) build a model whereby a bigger pool of portfolio investors encourages listed firms to adopt riskier business strategies with greater expected profits. More aggressive risk-taking by listed firms also leads unlisted firms to adopt riskier strategies in their model, raising firm level volatility throughout the economy. In the model of Acemoglu (2005), risk-taking by firms increases with aggregate capital accumulation, technical progress and financial development, so that firm level volatility naturally rises with economic development. Acemoglu stresses that his model can deliver a rise in firm level volatility accompanied by a fall in aggregate volatility.

Another line of research stresses the role of competition in goods markets. Philippon (2003) considers a model with nominal rigidities that links goods-market competition to firm level and aggregate volatility. In his model, greater competition in the form of a bigger substitution elasticity among consumption goods magnifies the effects of idiosyncratic shocks on profitability. As a result, greater competition leads to more firm level volatility in sales growth and a higher frequency of price adjustments. In turn, more frequent price adjustments dampen the response to aggregate demand disturbances in a calibrated version of the model. Thus, insofar as aggregate demand shocks drive aggregate fluctuations, Philippon's model produces divergent trends in aggregate and firm level volatility. Comin and Mulani (2005) argue that increased R&D-based competition leads to more firm level volatility but weaker comovements and, hence, lower aggregate volatility. As Acemoglu (2005) points out, however, R&D investments can act to increase or decrease competitive intensity, and the link to aggregate volatility is also tenuous. Comin and Philippon (2005) point to deregulation as a source of greater goods-market competition and rising firm level volatility. While deregulation is likely to increase firm level volatility in the short term, its longer term impact is less clear. For example, when regulatory restrictions hamper horizontal consolidation, deregulation can lead to an industry structure with fewer, larger firms. Horizontal consolidation is, in turn, a force for less firm level volatility. The removal of regulatory restrictions on branching and interstate banking accelerated this evolutionary pattern in the U.S. banking sector (Jayaratne and Strahan, 1998).

Although recent work focuses on the potential for better risk-sharing opportunities or greater goods-market competition to produce opposite trends in aggregate and firm level volatility, there is a simple mechanical reason to anticipate that micro and macro volatility will trend in the same direction. To see the argument, write the firm level growth rate as a linear function of K aggregate shocks that (potentially) affect all firms and an idiosyncratic shock, ε_i, that affects only firm i:

$$\gamma_{it} = \sum_{k=1}^{K} \beta_{ik} Z_{kt} + \varepsilon_{it}, \quad i = 1, 2, \ldots N. \tag{1}$$

The aggregate growth rate is $\sum_i \alpha_{it}\gamma_{it}$, where α_i is firm *i*'s share of aggregate activity. Assuming mutually uncorrelated shocks, equation (1) implies the following expressions for firm level and aggregate volatility:

$$\text{Weighted Mean Firm-Level Volatility} = \sum_{i=1}^{n} \alpha_{it}\sigma_{\varepsilon t}^2 + \sum_{i=1}^{n} \alpha_{it}\left[\sum_{k=1}^{K} \beta_{ik}^2 \sigma_{kt}^2\right] \tag{2}$$

$$\text{Aggregate Volatility} = \sum_i \alpha_{it}^2 \sigma_{it}^2 + \sum_i \alpha_{it}^2 \left[\sum_{k=1}^{K} \beta_{ik}^2 \sigma_{kt}^2\right] + 2\sum_{j>i}^{n} \alpha_{it}\alpha_{jt}\left[\sum_{k=1}^{K} \beta_{ik}\beta_{jk}\sigma_{kt}^2\right] \tag{3}$$

In light of the positive comovements that typify aggregate fluctuations, we assume that the weighted cross-product of the β coefficients is positive for each *k*.

Inspecting (2) and (3), we see that firm level and aggregate volatility respond in the same direction to a change in any one of the shock variances, provided that the firm shares α_i and the shock response coefficients β_{ik} are reasonably stable. In particular, a decline in the variability of aggregate shocks leads to a decline in both aggregate and firm level volatility. Hence, insofar as the well-established secular decline in aggregate volatility reflects a decline in the size or frequency of aggregate shocks, we anticipate a decline in average firm level volatility as well. Another argument stresses the importance of idiosyncratic shocks to large firms. Especially if σ_i is independent of size (α_i) at the upper end of the firm size distribution, as in Gabaix's (2005) granular theory of aggregate fluctuations, trend changes in the volatility of idiosyncratic shocks for, say, the 100 largest firms can be a powerful force that drives micro and macro volatility in the same direction. Of course, (2) and (3) do not require that aggregate and firm level volatility trend in the same direction. A mix of positive and negative changes in the shock variances could drive micro and macro volatility measures in opposite directions, as could certain changes in the pattern of shock-response coefficients or the business size distribution. Still, big trends in the opposite direction for micro and macro volatility strike us as an unlikely outcome.

Evolutions in market structure can also drive the trend in firm volatility, particularly in sectors that undergo sweeping transformations. Consider Retail Trade. The expansion of Wal-Mart, Target, Staples, Best Buy, Home Depot, Borders and other national chains has propelled the entry of large retail outlets and displaced thousands of independent and smaller retail establishments and firms.[7] In its initial phase, this transformation involved high entry and exit rates, but over time the industry size distribution shifted towards larger establishments and much larger firms. Empirical studies routinely find a strong negative relationship between business size and volatility. Hence, we anticipate that the transformation of the retail sector led to a secular decline in the volatility and dispersion of growth rates among retail businesses.

One other key issue involves the impact of developments that expand business access to equity markets. Financial developments of this sort can profoundly alter the mix of publicly traded firms and drive volatility trends among those firms that are unrepresentative of trends for seasoned public firms and the economy as a whole. Some previous studies point strongly in that direction. For example, Fama and French (2004) report that the number of new lists (mostly IPOs) on major U.S. stock markets jumped from 156 per year in 1973-1979 to 549 per year in 1980-2001. Remarkably, about 10% of listed firms are new each year from 1980 to 2001. Fama and French also provide compelling evidence that new lists are much riskier than seasoned firms and increasingly so from 1980 to 2001. They conclude that the upsurge of new listings explains much of the trend increase in idiosyncratic stock return volatility documented by Campbell et al. (2001). They also suggest that there was a decline in the cost of equity that allowed weaker firms and those with more distant payoffs to issue public equity. Fink et al. (2005) provide additional evidence in support of these conclusions. They report that firm age at IPO date (measured from its founding date or date of incorporation) fell dramatically from nearly 40 years old in the early 1960s to less than 5 years old by the late 1990s. They find that the positive trend in idiosyncratic risk is fully explained by the proportion of young firms in the market. After controlling for age and other measures of firm maturity (book-to-market, size, profitability), they find a negative trend in idiosyncratic risk. These studies imply that the economic process governing selection into the set of publicly traded firms shifted dramatically after 1979, and that the shift continued to intensify through the late 1990s.

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[7] See McKinsey Global Institute (2001), Foster, Haltiwanger and Krizan (2005) and Jarmin, Klimek and Miranda (2005) for evidence and analysis of the market structure transformation in the U.S. retail sector.

III. Data and Measurement

A. Source Data: The LBD and COMPUSTAT

The Longitudinal Business Database (LBD) is constructed from the Census Bureau's Business Register of U.S. businesses with paid employees and enhanced with survey data collections. The LBD covers all sectors of the economy and all geographic areas and currently runs from 1976 to 2001. In recent years, it contains over 6 million establishment records and almost five million firm records per year. Basic data items include employment, payroll, 4-digit SIC, employer identification numbers, business name, and information about location.[8] Identifiers in the LBD files enable us to compute growth rate measures for establishments and firms.[9] Firms in the LBD are defined based on operational control, and all establishments under the operational control of a parent firm are included as part of the parent's activity measures. We restrict attention in this study to nonfarm businesses in the private sector.

We also exploit COMPUSTAT data from 1950 to 2004.[10] A unit of observation in COMPUSTAT is a publicly traded security identified by a CUSIP. We exclude certain CUSIPs because they reflect duplicate records for a particular firm, multiple security issues for the same firm, or because they do not correspond to firms in the usual sense. Duplicate entries for the same firm (reflecting more than one 10-K filing in the same year) are few in number but can be quite large (more than 500,000 workers). We also exclude CUSIPs for American Depository Receipts (ADRs) – securities created by U.S. banks to permit U.S.-based trading of stocks listed on foreign exchanges. All together, we exclude approximately 1100 CUSIPs because of duplicates and ADRs. The presence of duplicates, ADRs and other features of COMPUSTAT imply the need for caution in measuring firm level outcomes and in linking COMPUSTAT records to the LBD.

We use COMPUSTAT to supplement the LBD with information on whether firms are publicly traded. For this purpose, we created a bridge file that links LBD and COMPUSTAT records based on business taxpayer identification numbers (EINs) and

[8] Sales data are available in the LBD from 1994. Sales data from the Economic Censuses are available every five years for earlier years. More recent years in the LBD record industry on a NAICS basis.
[9] See the data appendix regarding the construction of longitudinal links, which are critical for our analysis.
[10] Our COMPUSTAT data are from the same provider (WRDS) as in recent work by Comin and Mulani (2003), Comin and Philippon (2005) and others.

business name and address.[11] Missing data on equity prices, sales and employment data for some COMPUSTAT records do not cause problems for our LBD-based analysis, because we rely on LBD employment data whether or not the COMPUSTAT data are missing. Our matching procedures also work when there are holes in the COMPUSTAT data. In particular, we classify a firm in the LBD as publicly traded in a given year if it matches to a COMPUSTAT CUSIP by EIN or name and address, and if the CUSIP has non-missing equity price data in the same year or in years that bracket the given year.

Table 1 presents LBD and COMPUSTAT summary statistics for firm counts, employment and firm size in selected years. As of 2000, the LBD has almost five million firms with positive employment in the nonfarm private sector, of which we identify more than 7000 as publicly traded. Average LBD firm size in 2000 is about 18 employees, which is tiny compared to the average of 4,000 employees for publicly traded firms. Publicly traded firms account for a trivial fraction of all firms, but they account for 27-31% of private nonfarm employment during the period covered by the LBD. The highly skewed nature of the firm size distribution is also apparent in the enormous difference between average firm size and the employment-weighted mean firm size (the coworker mean). For example, the upper panel of Table 1 reports a coworker mean of 92,604 employees at publicly traded firms in the LBD in 2000, roughly 23 times larger than the simple mean of firm size. The highly skewed nature of the firm size distribution implies the potential for equally weighted and size-weighted measures of business volatility and dispersion to behave in dissimilar ways.

Comparisons between the upper and lower panels of Table 1 require some care, because the LBD and COMPUSTAT differ in how they define a firm and in how key variables are measured. LBD employment reflects the count of workers on the payroll during the pay period covering the 12th of March. The employment concept is all employees subject to U.S. payroll taxes. COMPUSTAT employment is the number of company workers reported to shareholders. It may be an average number of employees during the year or a year-end figure. More important, it includes all employees of all consolidated subsidiaries, domestic and foreign. For this reason, discrepancies between

[11] See McCue and Jarmin (2005) for details. We extend their methodology to include the whole period covered by the LBD.

the LBD and COMPUSTAT are likely to be greater for large multinationals and for foreign firms with U.S. operations (and listings on U.S. stock exchanges). Since the source data from annual reports can be incomplete, some COMPUSTAT firms have missing employment even when the firm has positive sales and a positive market value.

With these cautions in mind, consider the lower panel of Table 1 and its relationship to the upper panel. The lower panel provides information about the match rate in the LBD/COMPUSTAT Bridge. In 1990, for example, there are 6239 CUSIPs with positive COMPUSTAT employment. We match 5716 of these CUSIPs to firms in the LBD, which amounts to 92% of COMPUSTAT firms with positive employment and 92% of COMPUSTAT employment.[12] It is instructive to compare total employment, average firm size and the coworker mean between the upper and lower panels of Table 1 for the bridge cases. COMPUSTAT figures for these quantities exceed the corresponding LBD statistics by a very wide margin in all years. These large discrepancies for matched cases reflect important differences in the LBD and COMPUSTAT employment concepts, e.g., domestic versus global operations. See the Data Appendix for additional comparisons between the two data sources, and a discussion of how we distinguish de novo firm entry from ownership changes, mergers and acquisitions.

To sum up, the LBD provides data from 1976 to 2001 on the universe of firms and establishments with at least one employee in the U.S. private sector. We identify publicly traded firms in the LBD using our COMPUSTAT/LBD Bridge. The empirical analysis below focuses on the LBD, but we carry out some exercises on COMPUSTAT data as well.

B. Measuring Firm Growth, Volatility and Cross Sectional Dispersion

We study longer term movements in the volatility and dispersion of annual growth rates for establishments and firms. We focus on employment as our activity measure because it is readily available in the LBD and COMPUSTAT. Recall from

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[12] If we require that matches have positive COMPUSTAT employment *and* positive LBD employment in 1990, then the number of matched CUSIPs drops from 5716 to 5035. However, this requirement is overly restrictive in light of our previous remarks about missing COMPUSTAT employment observations, the inclusion of employment from foreign operations in COMPUSTAT, and timing differences between COMPUSTAT and the LBD. For instance, when we relax this requirement and instead allow CUSIPs with positive sales, price or employment to match to LBD firms with positive employment, then the number of matches exceeds 5700.

Figure 1 that volatility trends for employment and sales growth rates are similar in COMPUSTAT data.

Given the unbalanced nature of the LBD panel, we use a growth rate measure that accommodates entry and exit. Failure to incorporate entry and exit can yield misleading characterizations of volatility and dispersion magnitudes and trends. In particular, our time-*t* growth rate measure for firm or establishment *i* is

$$\gamma_{it} = \frac{x_{it} - x_{it-1}}{(x_{it} + x_{it-1})/2}. \tag{4}$$

This growth rate measure has become standard in work on labor market flows, because it offers significant advantages relative to log changes and growth rates calculated on initial employment. In particular, it yields measures that are symmetric about zero and bounded, affording an integrated treatment of births, deaths and continuers. It also lends itself to consistent aggregation, and it is identical to log changes up to a second-order Taylor Series expansion. See Tornqvist, Vartia and Vartia (1985) and the appendix to Davis, Haltiwanger and Schuh (1996) for additional discussion.

To characterize the distribution of business outcomes, we consider several related measures that fall into two broad categories: cross sectional *dispersion* in business growth rates, and *volatility* in business growth rates. Our basic dispersion measure is the cross sectional standard deviation of the annul growth rates in (4). Our basic volatility measure follows recent work by Comin and Mulani (2003, 2005) and Comin and Philippon (2005), among others. They measure volatility for firm *i* at *t* by

$$\sigma_{it} = \left[\frac{1}{10} \sum_{\tau=-4}^{5} (\gamma_{i,t+\tau} - \bar{\gamma}_{it})^2 \right]^{1/2}, \tag{5}$$

where $\bar{\gamma}_{it}$ is the simple mean growth rate for *i* from *t-4* to *t+5*. This measure requires ten consecutive observations on the firm's growth rates; hence, short-lived firms and entry and exit are not captured.[13]

[13] When we implement (5) using LBD data, we permit the firm to enter or exit at the beginning or end of the ten-year window. This is a small difference in measurement procedures relative to Comin and Mulani (2003, 2005) and Comin and Philippon (2005). A more important difference is that our LBD-based calculations include the pre-public and post-public history of firms that are publicly traded at *t* but privately held before or after *t*. As a related point, we do not treat listing and de-listing in COMPUSTAT as firm entry and exit.

Limiting the analysis to firms and establishments with ten continuous years of positive activity is quite restrictive, given the high pace of business entry and exit in the U.S. economy. Hence, we also consider a modified measure of business volatility that incorporates entry and exit and short-lived business units:

$$\sigma_{it}^{w} = \left[\left(z_{it} / \sum_{\tau=-4}^{5} z_{i,t+\tau} \right) \sum_{\tau=-4}^{5} (\gamma_{i,t+\tau} - \overline{\gamma}_{it}^{w})^2 \right]^{1/2} \tag{6}$$

where $z_{it} = .5(x_{it} + x_{it-1})$, the *w* superscripts denote size-weighted quantities, and $\overline{\gamma}_{it}^{w}$ is the size-weighted growth rate from *t-4* to *t+5* using the z_{it} as weights. We construct this measure for all businesses in year *t* with a positive value for z_{it}. In other words, we compute (6) on the same set of observations as the contemporaneous dispersion measure. As with equation (5), we only construct this measure for years in our data that we have four prior and five subsequent years of growth rates.

The dispersion and volatility measures described above can be calculated using equal weights or weights proportional to a measure of business size. We prefer size-weighted volatility and dispersion measures for most purposes, but we also report some equal-weighted measures for comparison to previous work. In the size-weighted measures, the weight for business *i* at *t* is proportional to z_{it}.

Summing up, our dispersion measures reflect year-to-year, between-firm variation in growth rates. Our volatility measures reflect year-to-year, within-firm variation in growth rates. Some volatility measures restrict analysis to long-lived firms, but we also consider volatility measures defined over the same observations as contemporaneous dispersion measures. Volatility and dispersion measures have different properties, and they highlight different aspects of business growth rate behavior. Still, they are closely related concepts. For example, if business growth rates are drawn from stochastic processes with contemporaneously correlated movements in second moments, then the cross-sectional dispersion in business growth rates and the average volatility of business growth rates are likely to move together over time.

C. Firm Volatility – Robustness to the Bridge Cases

To assess whether our results are sensitive to the use of publicly traded firms in the LBD/COMPUSTAT Bridge, we compare firm volatility for the full COMPUSTAT to firm volatility for matched cases. We consider all CUSIPs that match to the LBD in any year during the LBD overlap from 1976 to 2001. Figure 3 displays the comparison. It shows that restricting attention to those publicly traded firms that we identify in the LBD/COMPUSTAT Bridge has no material affect on the volatility results. This result gives us confidence that our LBD-based comparisons below of publicly traded and privately held firms are not distorted by inadequacies in our matching algorithm.

IV. Business Volatility and Dispersion Trends

A. Results using COMPUSTAT data on publicly traded firms

We now compare measures of volatility and dispersion in business growth rates using COMPUSTAT data. At this point, we do not restrict attention to firms in the bridge file.[14] Figure 4 shows the now-familiar pattern of rising firm volatility overlaid against a similar trend for the cross sectional dispersion of firm growth rates. To ensure an apples-to-apples comparison, we calculate dispersion using only those firm-year observations for which we calculate firm volatility.[15] While the volatility and dispersion measures capture different aspects of business growth dynamics, Figure 4 shows that they track each other very closely over the longer term. Note, however, that dispersion is uniformly larger than average firm volatility. In other words, between-firm variation in annual growth rates exceeds the average within-firm variation in annual growth rates at all times. The gap between the dispersion and volatility measures expanded over time from about 4 percentage points in 1955 to 7 percentage points in 1999. It is also worth remarking that the weighted measures are considerably smaller than the corresponding unweighted measures at all times. This pattern reflects the greater stability of growth rates at larger firms. The weighted measures also show a smaller and less steady upward trend than the unweighted measures, as we saw earlier in Figure 1.

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[14] But we do exclude observations with growth rates of 2 and -2, because COMPUSTAT listing and de-listing typically do not reflect true entry and exit by firms. In the LBD-based analysis below, we include observations with growth rates of 2 and -2 (unless otherwise noted), because we can accurately identify true entry and exit in the LBD.
[15] We have also computed measures of cross sectional dispersion using all COMPUSTAT firms in a given year regardless of whether they have a full ten year window of positive activity and find the patterns for cross sectional dispersion are similar to those reported in Figure 4. We note that for the LBD that restricting to cases with a full ten year MA window has a much larger impact given the important role of entry and exit in the LBD.

The rest of paper reports weighted measures of dispersion and volatility, because we think the weighted results are more relevant for aggregate behavior. Moreover, on an unweighted basis, publicly traded firms have negligible effects on dispersion and volatility measures for the whole private sector, because they are few in number.

B. Results using firm level data in the Longitudinal Business Database

A concern with COMPUSTAT-based results is whether they generalize to the entire economy. Figure 5 exploits LBD data to address this concern. The figure shows large declines in the volatility and dispersion of firm growth rates for the private sector and even larger declines among privately held firms. The dispersion in growth rates falls by about 13 percentage points from 1978 to 2000 in the private sector and by about 20 percentage points among privately held firms.[16] The average magnitude of firm level volatility falls by about 10 percentage points from 1981 to 1996 in the private sector and by about 17 percentage points among privately held firms. The volatility decline in the private sector over this period is more than 40% of its 1981 value, a striking contrast to the rise in volatility among publicly traded firms.

The rise in volatility among publicly traded firms in LBD data (Figure 5) is slightly smaller in magnitude than the rise in volatility among publicly traded firms in COMPUSTAT data (Figure 4) for the 1981 to 1996 period. As is evident in Figure 4, this time period exhibits a less rapid pace in the increase in firm level volatility for publicly traded firms than before 1981 and after 1996. Moreover, the level of volatility among publicly traded firms is much lower in LBD data. One possible explanation for this latter difference is the inclusion of foreign operations in COMPUSTAT activity measures for multinational firms. This issue merits further investigation.

Our LBD-based results also show that the publicly traded and privately held sectors experience very different levels of volatility, even on a weighted basis. Privately held firms are much more volatile and their growth rates show much higher dispersion. This is not particularly surprising, because a larger share of activity in the publicly traded sector is accounted for by older and larger firms that tend to be relatively stable. As

[16] Recall that we use all firm-year observations with positive values of z_{it} when computing our basic dispersion measure. That is, we include all continuing, entering and exiting firms. Below, we consider the effects of restricting the analysis to continuing firms only.

Figure 5 shows, however, publicly traded and privately held firms are converging in terms of the volatility and dispersion of their growth rates.

The finding that firm volatility in the private sector falls over time is consistent with previous findings in the job flows literature (Figure 2). It is also consistent with previous research using the LBD. One of the first findings from the LBD is a steady decline in establishment entry rates (Foster, 2003 and Jarmin, Klimek and Miranda, 2003). More recent work on the retail sector finds a decline in establishment and firm entry and exit in local retail markets, controlling for several factors (Jarmin, Klimek and Miranda, 2005). Jarmin et al. stress the changing structure of retail trade as one factor underlying the decline in entry and exit. They document the increasing share of activity in retail trade accounted for by large, national chains with many establishments and the decreasing share of activity accounted for by small, single-establishment firms.[17] This change in industry structure has a powerful effect, because entry and exit rates are substantially higher for small, single-unit establishment firms than for large national chains. We return to the role of industry structure and firm turnover in section V below.

Prior research emphasizes the process of entry and exit as an important component of overall volatility. Our basic cross sectional dispersion measure captures entry and exit. However, the firm level volatility measure based on equation (5) omits entry and exit entirely in COMPUSTAT-based analyses, and it captures entry and exit only for firms that operate continuously for at least ten years in LBD- based analyses. Short-lived firms are omitted altogether. These aspects of the volatility measure based on equation (5) are especially restrictive when applied to the whole private sector – most firms in the private sector do not survive 10 years. If the objective is to examine the overall magnitude of firm volatility, then it is desirable to use datasets and statistics that capture the most volatile units in the economy.

The modified firm level volatility measure based on equation (6) captures short-lived firms and entry and exit. It has the related advantage that it is calculated over the same set of firms as the dispersion measure. Motivated by these observations, Figure 6

[17] Foster, Haltiwanger and Krizan (2005) present related evidence using the Census of Retail Trade. They show that much of the increase in labor productivity in the 1990s in retail trade reflects the entry of relatively productive establishments owned by large national chains and the exit of less productive establishments owned by single-unit firms. See, also, McKinsey Global Institute (2001).

shows results for the volatility measure based on equation (6). We compute this measure for the 1981 to 1996 period (the same years as with the standard measure using equation (5)). The modified measure in Figure 6 captures much more volatility than the measure in Figure 5. Nevertheless, the overall patterns remain the same. Privately held business exhibit higher but falling volatility and publicly traded firms have lower but rising volatility.

V. Factors Underlying Observed Patterns

A. The Role of Firm Entry and Exit

The main finding reported in Section IV is that the patterns of cross sectional dispersion and firm level volatility differ substantially between privately held and publicly traded firms. One important factor that may underlie this difference is the role of entry and exit. The recent empirical literature on firm dynamics highlights the important role of entry and exit in accounting for the distribution of establishment and firm level growth rates. The relative importance of entry and exit is likely to differ across publicly traded and privately held firms since it is well established that firm turnover is substantially higher for younger and smaller firms (i.e., firms that are less likely to be publicly traded).[18]

To explore this issue, the top panel of Figure 7 presents results for cross sectional dispersion using an unbalanced panel of firms but only including firm-year observations for continuing firms in any given year (i.e., firms that did not enter or exit in that year). We find the results for the total economy and privately held firms are substantially impacted by excluding the contribution of entry and exit. For the total economy, we find that on a weighted basis cross sectional dispersion for continuing firms declines mildly from 1978 to 2000 by about 1 percentage point. For privately held firms, we find that on a weighted basis for continuing firms cross sectional dispersion declines by about 5 percentage points over the same time period. For publicly traded firms, we find that on a weighted basis cross sectional dispersion increases by about 12 percentage points for continuing firms.

[18] See Dunne, Roberts and Samuelson (1999), Davis and Haltiwanger (1999), and Davis et al. (2005) for evidence and discussion of the role of size and age for firm turnover.

Perhaps more importantly, excluding entering and exiting firms lowers overall volatility regardless of which measure is used. This is seen, in the case of cross sectional dispersion, by comparing figure 7a with 5a. Cross sectional dispersion is over 30 percentage points lower when we exclude entering and exiting firms.

The lower panel of figure 7 presents results for firm level volatility for continuing firms. Here the restriction is not only that the firm be a continuing firm in the current year but for the entire 10 year window over which the moving average within firm standard deviation is calculated. With these restrictions, we find that firm level volatility declines mildly for the total economy and privately held firms and is essentially flat for publicly traded firms. Again, comparing figures 5b and 7b shows that excluding firm births and deaths results in a dramatic reduction in overall firm volatility.

Finally, we provide direct evidence of the decline in firm turnover in Figure 8 which shows the employment-weighted firm turnover rate for the Total Economy. The firm turnover rate is measured as the sum of employment gains and losses from entering and exiting firms divided by total employment (averaged between t-1 and t). The firm turnover rate for the U.S. private sector falls substantially from a rate of almost 18 percent in the late 1970s to less than 10 percent by 2000.

In short, Figures 7 and 8 together with Figures 5 and 6 indicate that the patterns of cross sectional dispersion for privately held firms, and in turn the total economy, are very different when restricting to continuing firms only. The falling cross sectional dispersion and firm level volatility for privately held firms and the total economy is closely linked to the declining pace of firm turnover in the U.S. economy.

B. Role of Industry[19]

To help understand the factors underlying the patterns in section IV it is also useful to ask whether the patterns are similar across industries. Figure 9 shows the patterns of cross sectional dispersion and firm level volatility for selected 1-digit industries. Interestingly, the falling cross sectional dispersion is much more dramatic in

[19] In this section we focus on between industry differences in the patterns of cross sectional dispersion and firm level volatility. In unreported results, we have also examined whether the economy-wide patterns we focus on in section IV are robust to controlling for industry-year effects for firm level growth rates. That is, we consider measures of cross sectional dispersion and firm level volatility where the growth rate measure is the residual of the firm level growth from a regression on industry-year effects (interacted). We find that all of our results are robust to such controls. This latter finding suggests that the patterns we detect are being driven by within industry as opposed to between industry changes in the distribution of growth rates.

the Retail Trade and Service sectors than in Manufacturing (where it is basically flat). Firm level volatility is declining for each of these sectors but again the decline is much more dramatic for the Retail Trade and Service sectors.

As noted in section IV, this evidence of an especially high decline in cross sectional dispersion and firm level volatility for Retail Trade is consistent with other recent evidence for Retail Trade in Foster (2003), Foster et al. (2005) and Jarmin, Klimek and Miranda (2003, 2005). These studies emphasize the changing structure of retail trade with an increasing share of retail trade activity over the last couple of decades accounted for by large, national chain firms with many establishments. The establishments and firms from large, national chains are less volatile with the entry and exit rates of both establishments and firms for these large, national chains substantially lower than for single unit establishment firms. There may be many factors underlying this shift towards large national chains in the U.S. Retail Trade Sector. One potential factor discussed actively in the recent literature is the role of information technology (Doms, Jarmin and Klimek, 2004). Information technology has permitted the most successful large national chains (e.g., Wal-Mart) to innovate in their inventory and supply chain management. Large, national chains arguably have an advantage in taking advantage of information technology in this manner relative to single-unit establishment firms.

C. Firm vs. Establishment Patterns

In interpreting changes in the distribution of firm growth rates as measured by either cross sectional dispersion or firm level volatility, changes in the firm-establishment structure of the economy could be important. For example, in the Retail Trade sector we have already noted that there has been a shift away from single unit establishment firms to large, national chains with many establishments spread throughout the country. This structural shift likely underlies some of the patterns observed in Retail Trade in particular and in other industries that have also undergone such structural changes. A shift towards multi-unit firms can yield declining dispersion via simple statistical aggregation in the presence of establishment-specific volatility in growth rates.

One way to explore this issue is to examine the patterns of cross sectional dispersion and firm level volatility (in this case literally establishment level volatility) at the establishment level. Figure 10 presents results at the establishment level for the total economy and publicly and privately held establishments. Publicly traded establishments are those establishments that are owned by a publicly trade firm. The top panel of Figure 10 shows that cross sectional dispersion for all establishments also shows declining dispersion. On a weighted basis, the 3 year MA standard deviation of establishment growth falls by about 7 percentage points from 1978 to 2000. Cross sectional dispersion for establishment growth rates also declines secularly on weighted basis for privately held and rises secularly for publicly held on weighted basis. From 1978 to 2000, the 3 year MA declines by 14 percentage points on a weighted basis for privately held establishments. Over the same period, the 3 year MA dispersion for establishments owned by publicly traded firms increases by 10 percentage points on a weighted basis. These patterns are similar to those found for firms in Figures 5, although the establishment level cross sectional dispersion measures exhibit more high frequency variation. It is interesting to note that, by the year 2000, the rates of cross sectional dispersion for publicly traded and privately held establishments have more or less converged.

The lower panel of Figure 10 depicts establishment level volatility using the modified measure of within establishment volatility given by equation (6). We report results for equation (6) here since the restriction of a full ten years of positive z_{it} is especially restrictive for establishments. For the total economy and for privately traded establishments, we observe a decline in volatility from 1981 to 1996 but with some high frequency variation. For publicly traded establishments, the pattern exhibits an increasing trend.

Comparing Figures 5 and 6 (for firms) to Figure 10 (for establishments), the overall qualitative patterns are similar but there is an interesting difference in magnitudes for the publicly traded. The magnitudes of cross sectional dispersion as well as the volatility measure are higher for publicly traded establishments compared to publicly traded firms. These patterns make sense given statistical aggregation of in some cases many establishments within some of the large, publicly traded firms.[20]

D. *Changing Composition of Publicly Traded Firm: Cohort Effects*

[20] In unreported results we have also examined the analogue to Figure 8 for establishment turnover. Establishment level turnover exhibits a secular decline in a similar way to that reported for firm turnover in Figure 8.

Since cross sectional dispersion and firm level volatility are rising for publicly traded firms, falling for privately held firms and the magnitudes of both measures are higher for privately held firms than for publicly traded firms, a natural question to ask is whether the patterns for publicly traded firms reflect a changing composition of publicly traded firms. If, for example, the propensity to be publicly traded has increased over time because the cost of going public has declined, this factor alone could account for the rising cross sectional dispersion and firm level volatility for publicly traded firms. As we noted in section II, Fama and French (2004) have already provided evidence that new lists are riskier than seasoned firms and increasingly so over the last 20 years.

To explore this issue, we return to looking at COMPUSTAT data since this dataset offers a much longer time series to investigate such composition effects. We classify publicly traded firms into cohorts based upon the decade that they began to be publicly traded. Some firms are publicly traded in 1950 (the first year for which we have COMPUSTAT data) and they are denoted as "left-censored". For the remaining firms, we identify the decade over which they became publicly traded. Since COMPSUTAT has compositional changes due to new exchanges becoming part of COMPUSTAT in specific years (e.g., NASDAQ data became available in COMPUSTAT in 1973) for this exercise we excluded firms that join COMPUSTAT as part of the addition of an exchange to COMPUSTAT in the year that this exchange is added. New listings for such exchanges are included in this cohort analysis in years after any given exchange is added to COMPUSTAT – for example, a newly listed firm in 1980 that is part of NASDAQ is in the cohort analysis. We have verified that excluding the firms that are added to COMPUSTAT from added exchanges does not change the overall patterns as exhibited, for example, in Figure 4 of section IV.

The top panel of Figure 11 shows the shares of COMPUSTAT employment accounted for by the various cohorts. By construction, the left censored cohort (the 1950 firms) accounts for all of the employment in 1950 but interestingly by 2004 this group accounts for only 20 percent of employment. Each cohort is observed to show a rising share of employment as it ages with the 1990s cohort exhibiting an especially rapid increase in its share as it aged.

The lower panel of Figure 11 depicts the firm level volatility measures for each of the cohorts including the left censored group. A number of interesting patterns emerge. First, firm level volatility is increasing by cohort almost uniformly although for older cohorts (e.g., 1960s and before) have quite similar volatility by 2000.

Second, for many but not all cohorts, firm level volatility falls for the first couple of years after the cohort has entered. Recall that since the firm level volatility measure can only be computed for firms with a full ten-year window of activity, so that for say the 1980 cohort, the firm level volatility measure can only be constructed starting in 1985. Thus, the first year of the firm level volatility computed includes the growth rate from the first year of positive activity to the second year of positive activity (a reminder that when using COMPUSTAT data we intentionally exclude entry and exit growth rates since for new listings this is typically not the entry of the firm but the year the firm is listed for the first time). Not surprisingly, firm level volatility is relatively high for new listings.

Third, for many cohorts, there is some time series variation in firm level volatility but no striking upward trend. The 1980s cohort exhibits the most noticeable increase in firm level volatility in the second half of the 1990s when overall firm level volatility is increasing rapidly as seen in Figures 1 and 4. The 1970s cohort also exhibits an increase and the left-censored (1950 vintage) firms exhibit a very modest increase in volatility in this during the 90's. Interestingly, firm level volatility for the original left censored groups is more or less the same in 2000 as it was in 1955.

Putting the top and bottom panels together suggests that composition effects across cohorts have played an important role in accounting for the rising firm level volatility for publicly traded firms. That is, the shares of the more recent cohorts have increased over time (in part by construction) but it is also the case that more recent cohorts are more volatile even controlling for age.

E. Changing Composition of Publicly Traded Firms: Industry Effects

The prior section emphasizes the role of differences in firm volatility across cohorts of publicly traded firms. Earlier sections have emphasized not only the differences in firm volatility between privately held and publicly traded firms but also the differences in firm volatility across industries. These patterns suggest that it is of interest to explore changes in the composition of publicly traded firms relative to privately held firms for the total private sector and by industry.

The top panel of Figure 12 shows the share of total employment accounted for by publicly traded firms for the entire private sector and for selected 1-digit industries using the LBD. For the entire private sector publicly traded firms account for about 25 to 30 percent of U.S. payroll employment and this share has exhibited a mild decline from 1976 to 2001.[21] For the Retail Trade, FIRE and Service sectors the share has increased substantially over this period but for Manufacturing the share has declined. The lower panel of Figure 12 shows the share of publicly traded employment accounted for by different industries. Mimicking some of the patterns in the upper panel, the share of publicly traded employment accounted for by Retail Trade, FIRE and Services has increased substantially while the share of Manufacturing has declined. By 2001 the share of publicly traded employment accounted for by Retail Trade exceeds that accounted for by manufacturing.

Recall that in section V.B above, we showed that firm level volatility and cross sectional dispersion are uniformly higher in sectors like Retail Trade and Services than in Manufacturing. Combining these latter patterns with the evidence in Figure 2 suggests that part of the explanation for rising volatility among publicly traded firms is a shift within the publicly traded sector to Retail Trade and Services and away from Manufacturing.[22]

F. *The Relationship Between Cross Sectional Dispersion and Firm Level Volatility*

[21] In interpreting the magnitude of this share it is important to note that this is for domestic operations only so caution must be used in comparing total employment statistics for publicly traded firms from the LBD and total employment from COMPUSTAT given the importance of global operations for at least some publicly trade firms. In addition, while the match rate between the LBD and COMPUSTAT is very high in Table 1, there may be some non-matches that are legitimate nonfarm private firms with positive U.S. payroll employment. This may have a modest affect on the publicly traded share but is unlikely to have much effect on time series variation.

[22] In future drafts we will explore these issues further by directly by examining the patterns of firm level volatility and cross sectional dispersion by industry and publicly traded and privately held status simultaneously. We note that Figure 9 shows a much more rapid decline in cross sectional dispersion and firm level volatility for Retail Trade and Services relative to Manufacturing for *all* firms. It is of interest to explore these same industry patterns for publicly traded and privately held firms separately.

In practice, the empirical evidence presented above suggests a tight link between the changing patterns of cross sectional dispersion and firm level volatility. This tight link is especially apparent for publicly traded firms as seen in Figure 3.

To help explore the relationship between these two different summary measures of the distribution of firm level growth rates more formally, we consider some simple simulations. To start, consider a simple environment where firms draw idiosyncratic shocks impacting their growth from a distribution that is independently distributed over time at the micro level. That is, growth for firm i in period t is given by:

$$\gamma_{it} = \mu_t + \varepsilon_{it}$$

where μ_t is a common shock in period t and ε_{it} is a draw from an independently distributed distribution of shocks. Under this model, we are assuming the innovations to growth rates are uncorrelated over time but we permit the mean and the higher moments of the distribution to shift over time. As such, we can use the actual growth rate distribution (nonparametrically) and take draws from this distribution each year for a simulated sample of firms independently in each year.

In practice, we use a fine grid to capture the growth rate distribution in any given period and take into account the mass points in the distribution associated with entry (+2), exit (-2) and inertia (0) and for intervals between 0 and 2 and 0 and -2 we use growth rate bins with width of 0.01. In using the mass points at 2 (entry) and -2 exit in our simulations, we make exit an absorbing state and entry a one time event in our simulations. These assumptions are born out empirically as there are relatively few firms with multiple entries and exits. Using this fine grid and taking the mass points into account yields a time series of cross sectional dispersion measures that mimic the actual measures we have reported above. Using this distribution, we consider a simulated path with a one time change in the nonparametric distribution (where the one time change reflects an increase in the variance of the cross sectional growth rates). We accomplish this by taking a period with the low variance and a period with a high variance.

Using these two nonparametric distributions, we generate a simulated distribution of firms for the period 1977 to 2001 where the firms draw from the low variance distribution from 1977 through 1989 and then from the high variance distribution from 1990 to 2001. Using this simulated distribution of firms, we compute the cross sectional dispersion and firm level volatility measures. The simulated results from this exercise are reported in Figure 13. The one time change in the innovation distribution yields a once and for all increase in cross sectional distribution in 1990. The firm level volatility measure "anticipates" this one time increase as we see this measure increase before 1990 but also this measure continues to increase until around 1995 when the impact of the one time increase is included in the full ten year moving average.

The pattern in Figure 13 is not surprising but instructive. Under this simple model, cross sectional dispersion and firm level volatility will be tightly linked with firm level volatility smoothing out changes in cross sectional distribution in any given year with increases observed before and after the change in the variance of innovations. This simple model is an extreme model since it presumes zero autocorrelation of firm level growth rates. For continuing firms, we have estimated AR1 models by year and we have found that the typical AR1 coefficient in any given year for continuers is around -0.02 – that is slightly negative but close to zero. This finding suggests that the simple model we used in the above simulation may not be such a bad approximation. Put differently, a reasonable approximation might be the employment levels of firms are a random walk with drift so that growth rates have an approximate zero correlation.[23]

Our point here is not to take a definitive stand on the underlying statistical model that best captures firm level growth rates. Indeed we are confident that the above model where all firms draw from the same distribution each period is too simple especially for businesses that have recently entered. Studies show that recent entrants are more volatile than older businesses and, conditional on survival, grow faster than other incumbents. That is, there is strong evidence that there are important selection and learning effects for cohorts of entrants that involve rich and complex shakeout effects.[24] Moreover, given the above findings that suggest the patterns of entry and exit are important empirically for the time series evolution of cross sectional dispersion and firm level volatility, understanding

[23] A related point is that much literature has found that employment adjustments at the micro level are lumpy (see, e.g., Caballero et. al. (1997) and Caballero and Engel (2004)) so that the approximately zero autocorrelation of growth rates reflects in part many periods with little or "zero" change in employment followed by occasional large changes. The pattern of lumpy employment adjustment in turn raises interesting questions about whether the changing patterns of firm level volatility and cross sectional dispersion might reflect changes in the adjustment dynamics for firms.

[24] See for example Davis et. al. (2005) and Foster et. al. (2005).

and exploring the connection between the changing patterns of entry and exit and these measures of dispersion and volatility is important.

VI. CONCLUDING REMARKS

Comprehensive longitudinal data for the U.S. private sector reveal that volatility and cross sectional dispersion in employer growth rates fell markedly in recent decades. Measured in the same way as in other recent research, the employment-weighted mean volatility of firm growth rates in the private sector has declined by more than 40% since 1982. This result stands in sharp contrast to previous findings of rising volatility for publicly traded firms. We confirm the rise in volatility among publicly traded firms using a new data source, but we show that its impact is overwhelmed by a large trend decline in volatility among privately held firms. Mean volatility among privately held firms has declined by about 55% since 1981.

A big factor in the trend declines in volatility and dispersion is the slow down in the pace of business entry and exit. At least in part, lower entry and exit rates reflect major structural changes in certain industries. For example, firm level volatility in the U.S retail sector declined by about 50% from 1981 to 1996. Over the same time period, the retail sector underwent a pronounced shift away from relatively small firms and establishments toward national chains with many, larger establishments. National chains are less volatile than independent retailers, and they experience lower entry and exit rates.

To help understand the sharply divergent trends for privately held and publicly traded firms, we investigate compositional changes in the publicly traded sector. As previously reported in other studies, there was a large influx of newly listed firms after 1979. We find that recent cohorts of publicly traded firms are substantially more volatile than earlier cohorts even after controlling for age. Moreover, many of the more recent cohorts have grown rapidly in terms of their share of employment among publicly traded firms. The rising activity share, higher volatility and increasingly volatile character of newly listed firms explain much of the trend increase in volatility among publicly traded firms.

This paper exploits the newly developed LBD dataset to document and shed light on patterns of volatility and dispersion in business growth rates. Our findings illustrate the power and usefulness of comprehensive data sets that capture business entry and exit and privately held firms, which employ about 70% of all workers in the private sector. Our results show that a focus on large publicly traded firms can yield highly misleading impressions of developments in the economy as a whole, especially when there are significant changes in the process governing selection into the set of publicly traded firms.

Our findings also suggest promising directions for future research and raise a number of interesting questions. As we discussed in Section II, trends in firm-level volatility and the dispersion in business growth rates are relevant for several prominent theories of risk-sharing, unemployment, growth and fluctuations. The impressive magnitude of the trend changes that we document, the major differences across industries, and the dramatic divergence between publicly traded and privately held firms highlight major developments in the U.S. economy. These developments have potentially important implications for unemployment, worker flows, the pace and nature of restructuring activity, and the distinction between publicly traded and privately held firms. It is also rather striking that aggregate productivity growth rates rose after the 1980s while firm level volatility continued to fall in the private sector as a whole.

Questions raised by our results include the following: Do trend declines in business-level volatility reflect declining shock variances, a change in shock response dynamics, or some combination? Are the dramatic declines in employer volatility responsible for the big decline in U.S. unemployment rates since the early 1980s? Does greater wage flexibility provide a unified explanation for declining employer volatility, rising wage variability and declining unemployment? Can the sharply divergent trends for privately held and publicly traded firms be explained by changes in access to or the cost of public equity? How do trends in business volatility and dispersion measures inform our understanding of the decline in the aggregate volatility of the U.S. economy? Do other advanced economies exhibit a similar trend decline in firm level volatility and a similar divergence between volatility trends for privately held and publicly traded firms? We make little progress on these wide-ranging questions in this study, but our empirical findings suggest that they certainly merit attention.

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Data Appendix

A. LBD

This appendix discusses improvements to the LBD that aided the analysis in this paper. Recall that the LBD is comprised of longitudinally linked Business Register (BR) files. The BR is updated continuously and a snapshot is taken once a year after the incorporation of survey data collections to create the files used at CES to construct the LBD. These files contain a longitudinal establishment identifier, the Permanent Plant Number (PPN). This identifier is design to remain unchanged throughout the life of the establishment regardless of reorganizations or ownership changes. However, breaks in PPN links are known to exist and longitudinal identifiers are only available beginning in 1982. We first use numeric identifiers to construct longitudinal links. We then use commercially available statistical name and address matching software to enhance the numeric links in the file (see Jarmin and Miranda, 2002).

Construction of the longitudinal establishment links is relatively straightforward because they are one to one, and because establishments typically have well-defined physical locations. The construction of the firm links requires some additional work. Firm identifiers can be broken primarily as a result of firm expansions from single unit establishment entities to multi unit entities as well as merger and acquisition activity. In both cases firm identifiers can be created or destroyed from this type of activity, and thus lead to volatility in growth rates from entry and exit. We fix the first problem by assigning a unique firm identifier to firms expanding from single units establishments to multi unit establishments. This is straight forward since we are able to track establishments over time. Changes in firm identifiers due to merger and acquisition activity are harder to resolve since they are a many to many match. We do not address this issue directly in the current paper. In many ways, there is no clear right way to handle M&A since the expansion of an existing firm through the acquisition of another firm (or part of another firm) should likely be incorporated into measures of firm level volatility.

While we do not directly address the role of M&A activity, the results on cross sectional dispersion and firm level volatility using establishment level data provides useful indirect guidance about the role M&A activity for our current results. That is, comparing Figure 5 using firms and Figure 10 using establishments yields very similar patterns. Moreover, in unreported results we find that the falling firm turnover exhibited in Figure 8 also holds for establishments. By construction, M&A activity does not impact the establishment level linkages so the robustness of the findings to establishment cross sectional dispersion, firm level volatility and firm level turnover suggests our main findings are not associated with M&A activity. We note that, by using the establishment level linkages, we can explore this further and can provide a bound on the role of M&A activity by eliminating all firm-year observations that involve an existing establishment changing firm ownership. This includes new firms that own previously existing establishments; firms that die but where all establishments do not die and finally continuing firms that change the number of establishments where these are not all new. In future drafts of the paper, we will consider results which use these bounds.

The combination and reconciliation of administrative and survey data sources in the LBD lead to a more serious problem. The initial versions of the LBD contain a number of incorrectly timed establishment births and deaths. These come about from reconciling administrative data with census collections in BR processing. Understanding the structure of these files aids the discussion. At the core of the BR are administrative records from payroll and business income tax records. These forms contain information on the employment and payroll for employers as captured by the employer identification number, the EIN. However, the EIN is an administrative reporting unit that may or may not correspond with the single physical location where business is conducted, the establishment. In particular, multi establishment firms may combine information for several plants under a single EIN. In this case the EIN unit and the establishment unit are not the same. The process of identifying combined reports and reconciling administrative information with establishment level survey response data for the purpose of creating the underlying BR leads to incorrectly timed births and deaths for multi establishment companies. Incorrectly timed births and deaths appear primarily during Economic Census years when the most comprehensive updates to the BR occurs and show up in the LBD as spikes in multi unit establishment deaths and births.

We retime incorrectly timed deaths and births following a two-phase methodology.[25] The first phase involves using firm level information contained in the LBD to identify the correct birth year of as many establishments as we can. We examine changes in firm level employment and identify those that are consistent with the opening of the new establishment. The second phase involves using a modified version of Davis, Haltiwanger, Schuh (1996) to randomly assign the birth year of establishments whose birth year could not be resolved in phase one. The randomization is constrained so that the patterns of births and deaths for retimed cases match those of true birth/deaths observed in the data.[26]

Finally, the LBD contains a substantial number of establishments that appear (in the LBD) to become inactive for a temporary period of time (see Jarmin and Miranda, 2002b).[27] That is, the establishment is active in period *t-1* and *t+1* but not in period *t*. These gaps in the data lead to possible spurious startups and shutdowns since they are treated as births and deaths. Here we take a conservative approach by eliminating these establishment year observations in the entry and exit computations. Our goal in doing so is to focus on true entry and exit.

C. B. LBD/COMPUSTAT Match

Table 1 shows the differences between COMPUSTAT and LBD employment. This section provides further perspective on these differences both in levels and growth rates. Figure A.1 shows a scatter plot of log employment levels and employment growth rates (using the growth rate concept discussed in section III) using LBD vs. COMPUSTAT growth rates. Here we restrict cases to where this is a clean one-to-one match in a given year such that in both files the matched entities have positive employment in that year (so for example in 1990 this uses the 5035 CUSIPs noted above). For levels, much mass is concentrated along the 45 degree line but it is clear there are substantial discrepancies and that more of the discrepancies in levels are to the right of the 45 degree line. The simple correlations for log levels are 0.89 unweighted and 0.83 weighted. The standardized difference in employment between the LBD and COMPUSTAT at the firm level

[25] See Jarmin, Miranda (2005), "Reassigning Incorrectly Timed MU Births and Deaths".
[26] We construct birth/death retiming weights from observed births/death data using a conditional logit model. The model includes controls for state, metro and rural areas and job creation/destruction rates. The model is run separately by 2-digit SIC and for four different 5-year census cycles.
[27] There are between 40,000 and 120,000 cases each year.

(measured as the difference between LBD employment and COMPUSTAT employment divided by the average of LBD and COMPUSTAT employment) has a median of -0.13 and a mean of -0.26 on an unweighted basis and a median of -0.25 and a mean of -0.30 on an employment weighted basis which reflects more of the mass to the right of the 45 degree line in Figure A.1. For growth rates, the timing of the information is sufficiently different that we explored growth rates over five year intervals. Again, in the lower panel depicting the correlation of growth rates, there is much mass close to the 45 degree line but the correlations are lower. For growth rates, the correlations are 0.64 unweighted and 0.54 weighted. The somewhat lower correlations, for both levels and growth rates, using weighted results likely reflect that the difference in employment concepts (e.g., Global operations vs. U.S. payroll) is most severe for large, multinational firms.

Table 1: Summary Statistics for COMPUSTAT, LBD and Matched Data Sets

A. Summary Statistics for LBD Using LBD/COMPUSTAT Bridge

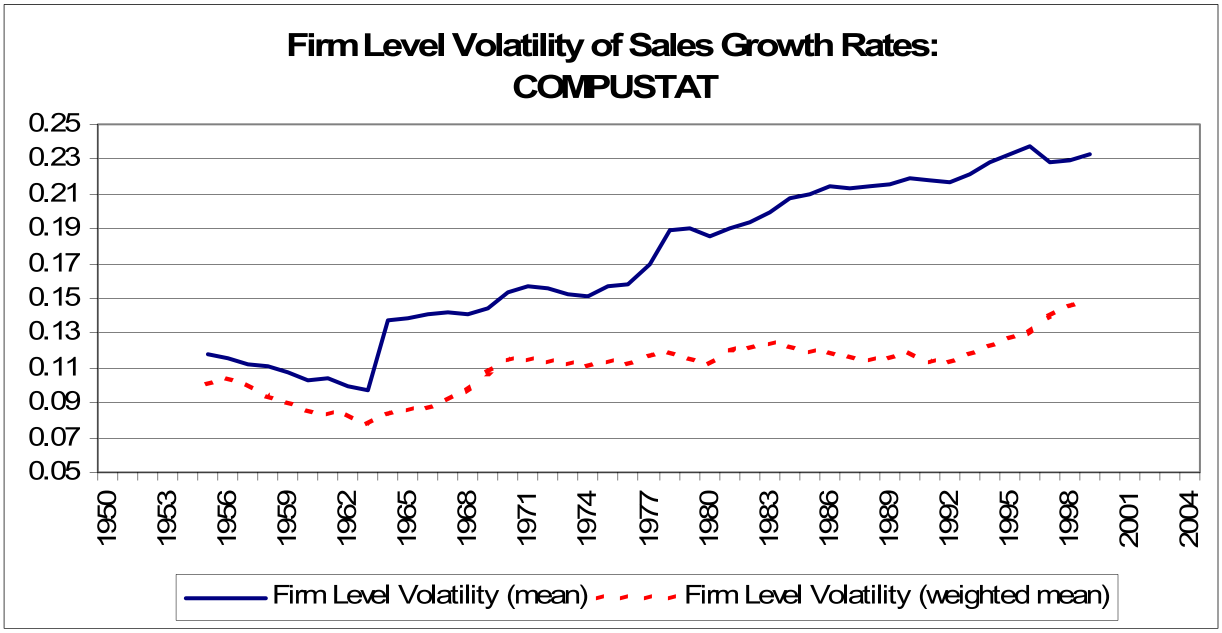
Year		Number of Firms	Total Employment	Average Employment	Coworker Mean
1980	Privately Held	3,530,307	51,622,693	14.6	2,736
	Publicly Traded (Bridge)	4,339	21,045,202	4,850.2	67,983
	Total	3,534,646	72,667,895	20.6	21,632
1990	Privately Held	4,222,385	68,896,957	16.3	4,235
	Publicly Traded (Bridge)	5,739	22,930,762	3,995.6	73,533
	Total	4,228,124	91,827,719	21.7	21,540
2000	Privately Held	4,744,020	83,845,864	17.7	4,761
	Publicly Traded (Bridge)	7,338	29,469,013	4,015.9	92,604
	Total	4,751,358	113,314,877	23.8	27,605

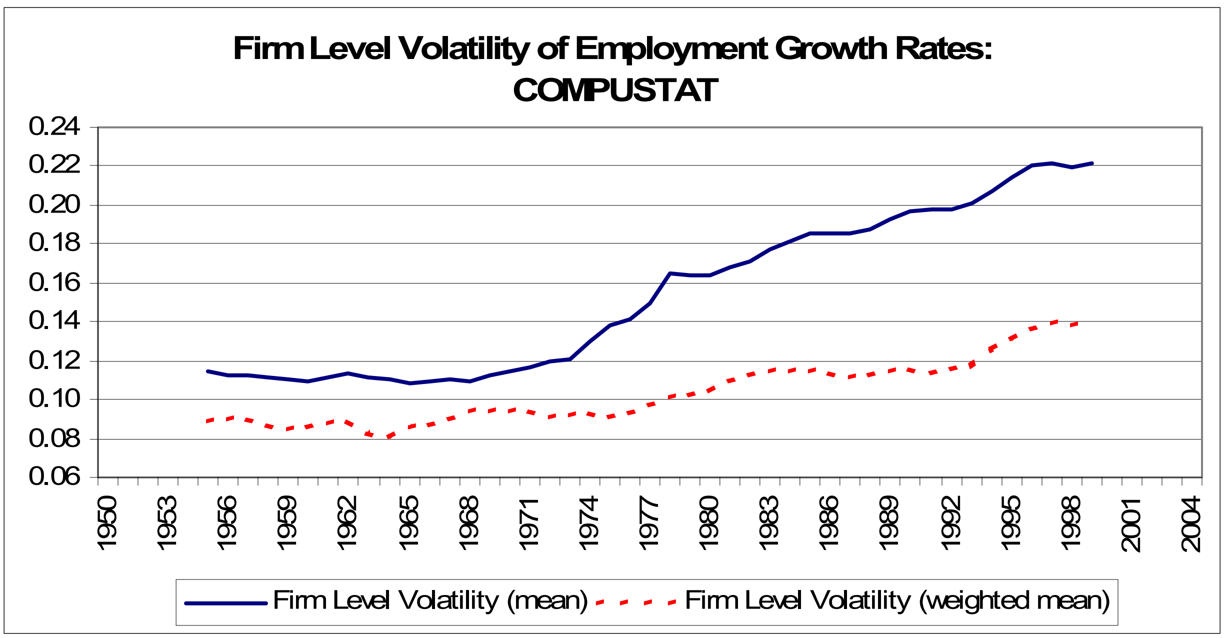
B. Summary Statistics for COMPUSTAT Using LBD/COMPUSTAT Bridge

Year		Number of CUSIPS with Positive Price	Number of CUSIPS with Positive Employment	Total Employment	Average Employ-ment	Coworker Mean
1980	LBD Match (Bridge)	3,995	4,672	29,729,396	6,363	114,630
	Not Matched	835	880	3,841,700	4,366	39,050
	Total	4,830	5,552	33,571,096	6,047	105,981
1990	LBD Match (Bridge)	5,986	5,716	31,755,052	5,555	110,374
	Not Matched	847	523	2,793,759	5,342	72,865
	Total	6,833	6,239	34,548,811	5,538	107,341
2000	LBD Match (Bridge)	8,394	7,168	40,672,986	5,674	137,678
	Not Matched	2,063	1,306	4,090,947	3,132	53,033
	Total	10,457	8,474	44,763,932	5,283	137,570

Notes: In panel A, an LBD firm is identified as publicly traded if it appears in the LBD/COMPUSTAT Bridge and its COMPUSTAT CUSIP has a positive security price for the indicated year or in years that bracket the indicated year. In panel B, a COMPUSTAT firm is identified as an LBD match if the CUSIP appears in the LBD/COMPUSTAT Bridge. In panel B, we do not require the LBD match to have positive payroll in current year. Average employment is the simple mean over firms of employment. The coworker mean is the employment-weighted mean firm size.

Figure 1: Firm Level Volatility for Publicly Traded Firms





Source: Own calculations from COMPUSTAT data.
Notes: Calculations exclude entry and exit. Firm volatility calculated according to equation (5).

Figure 2a: Quarterly Excess Job Reallocation Rate for U.S. Total Manufacturing, 1947-2005

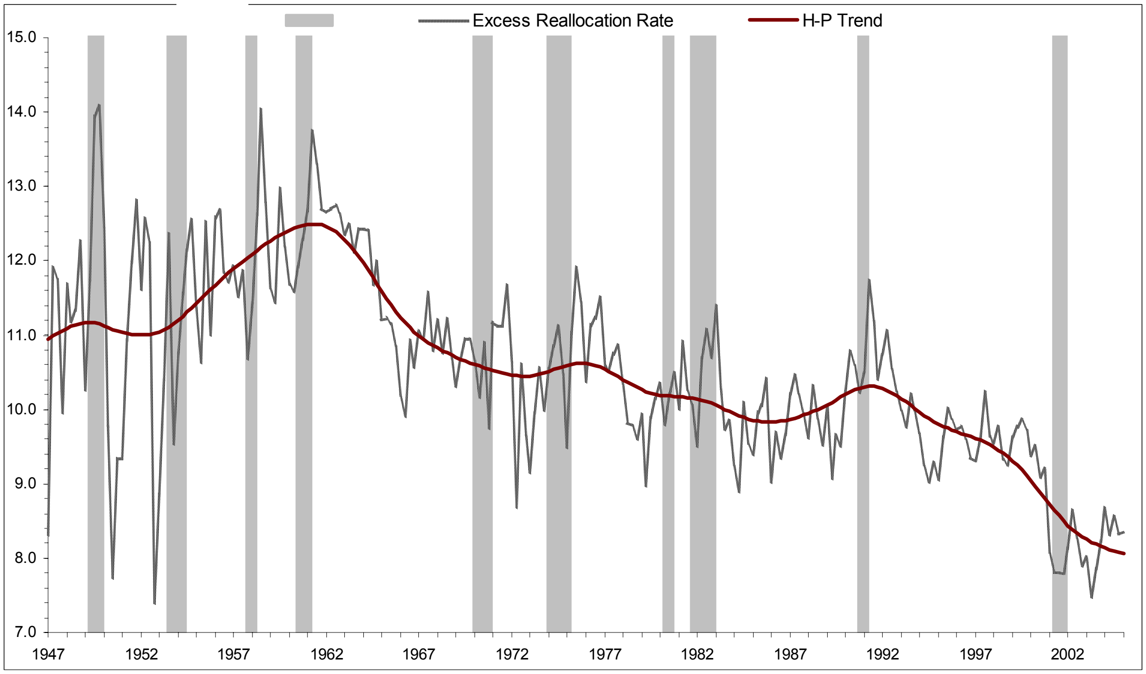
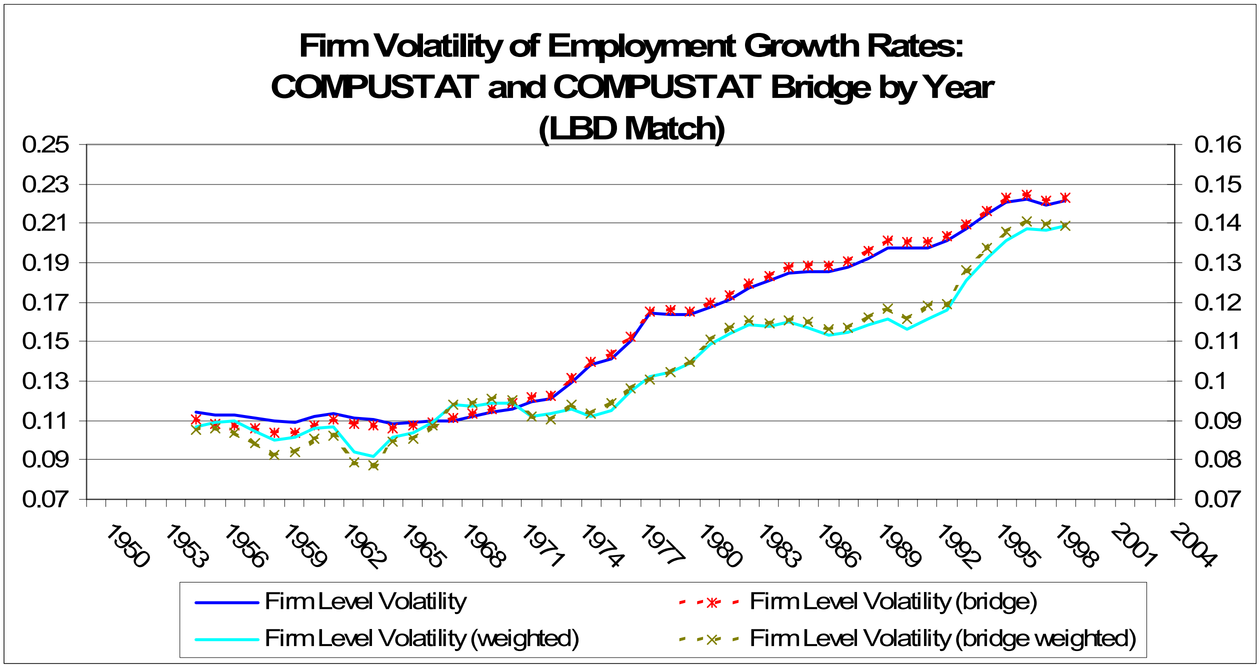


Figure 2b: Quarterly Excess Job Reallocation Rate for U.S. Private Sector, 1990-2005

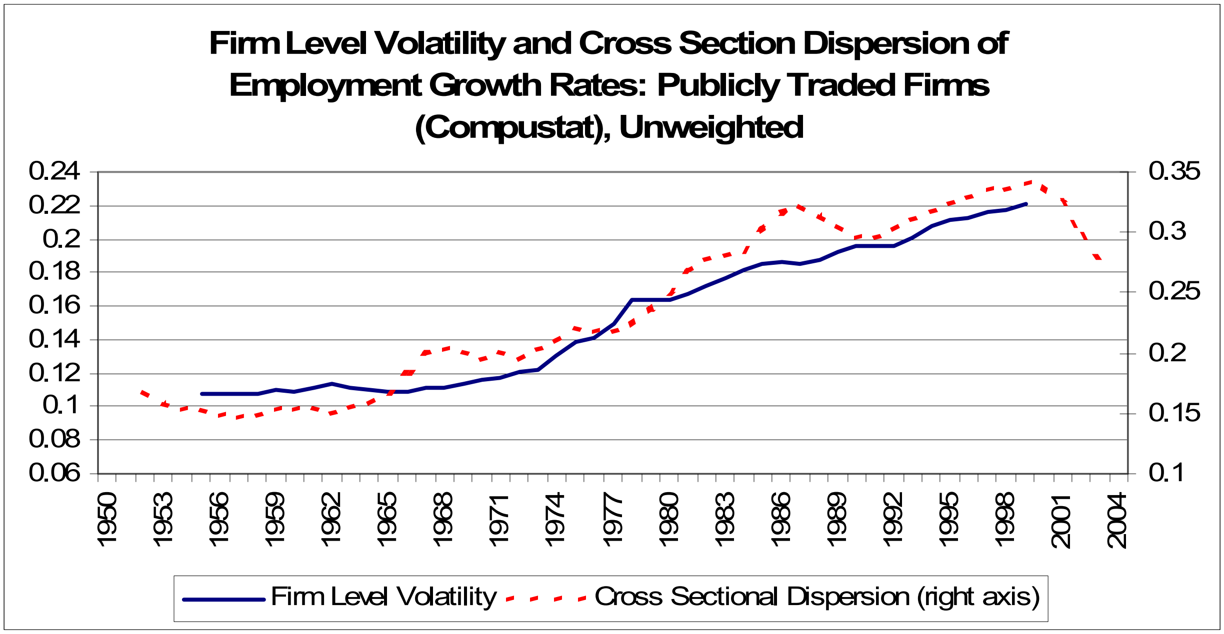
Source: Davis, Faberman and Haltiwanger (2005) and Faberman (2006)

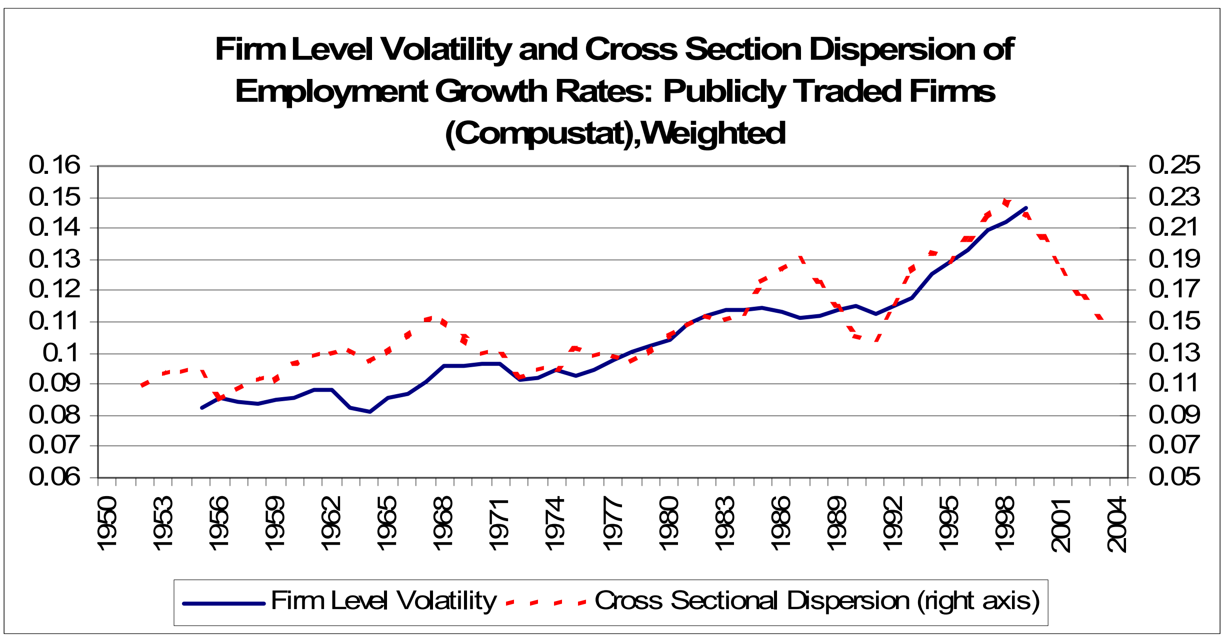
Figure 3: Firm Level Volatility: Full COMPUSTAT Compared to Bridge Cases



Source: Own calculations from COMPUSTAT data.
Notes: Calculations exclude COMPUSAT entry and exit. Firm volatility calculated according to equation (5).

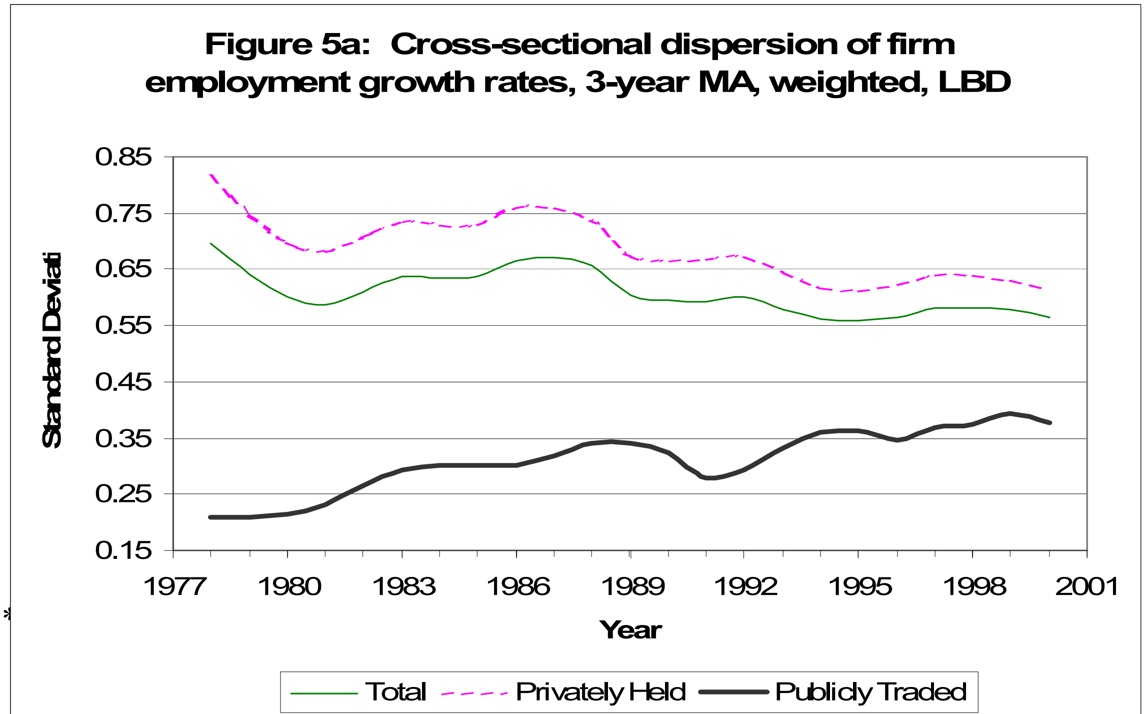
Figure 4: Volatility and Dispersion in Growth Rates Compared, COMPUSTAT data

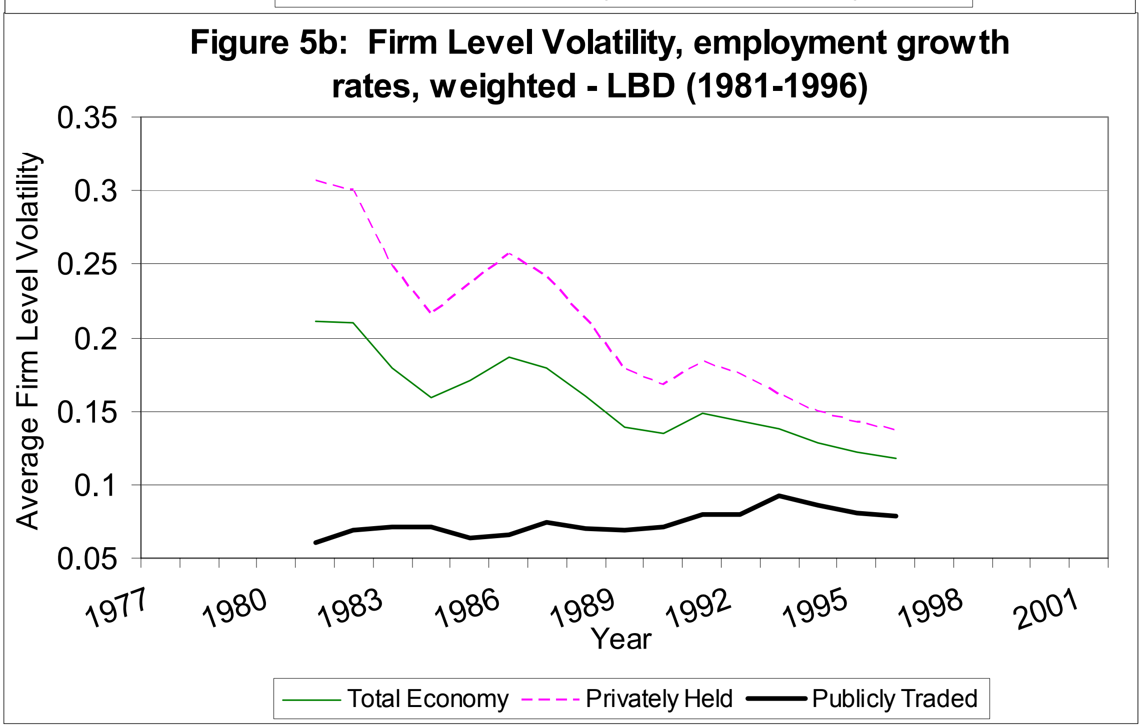




Source: Own calculations from COMPUSTAT data.
Notes: Calculations exclude COMPUSTAT entry and exit. Firm volatility calculated according to equation (5).

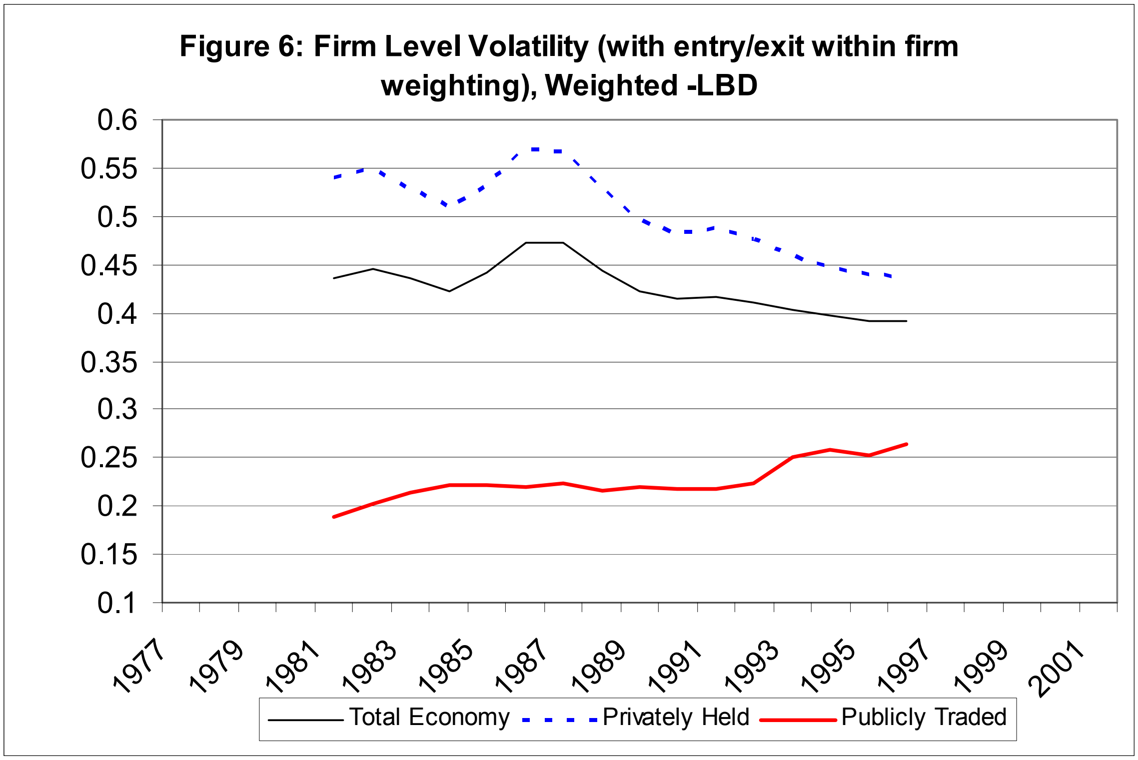
Figure 5: Volatility and Dispersion in Growth Rates, Publicly Traded versus Privately Held Firms, LBD Data





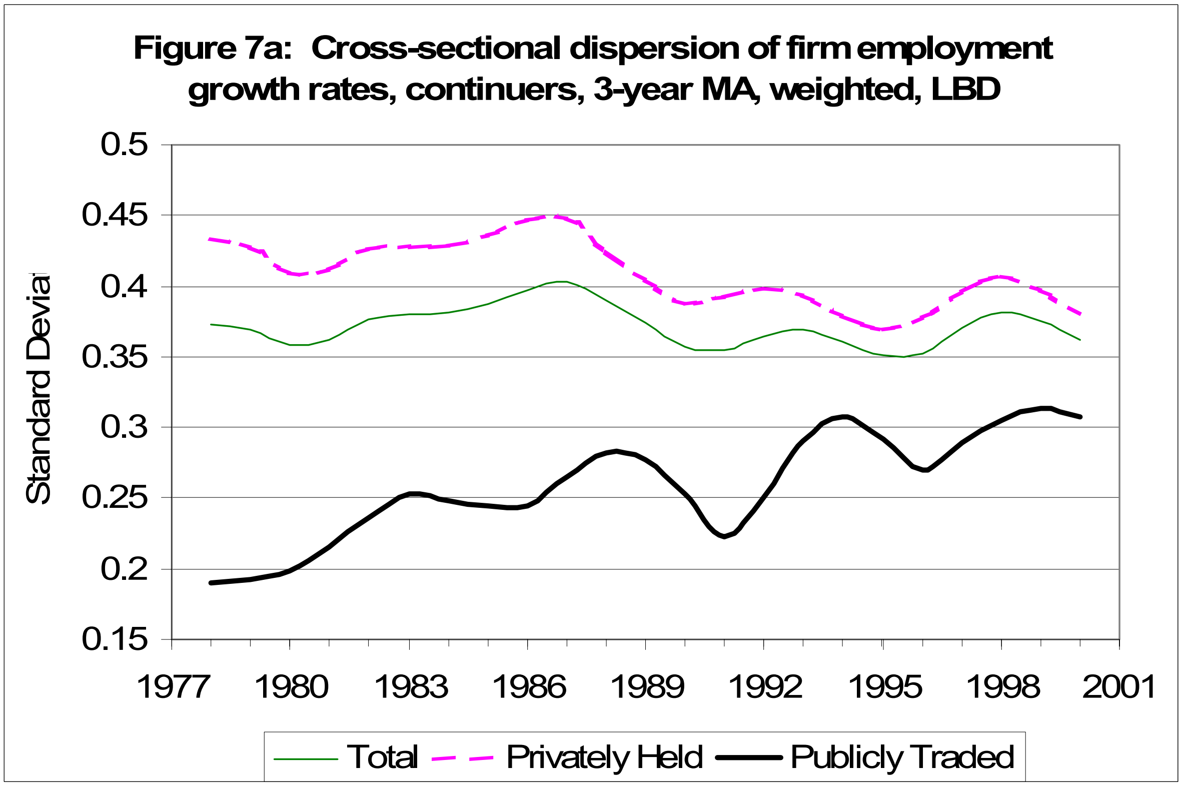
Source: Own calculations from LBD data.
Notes: Calculations in the top panel include entry and exit. Firm volatility in the bottom panel is calculated according to equation (5) and, hence, excludes short-lived firms.

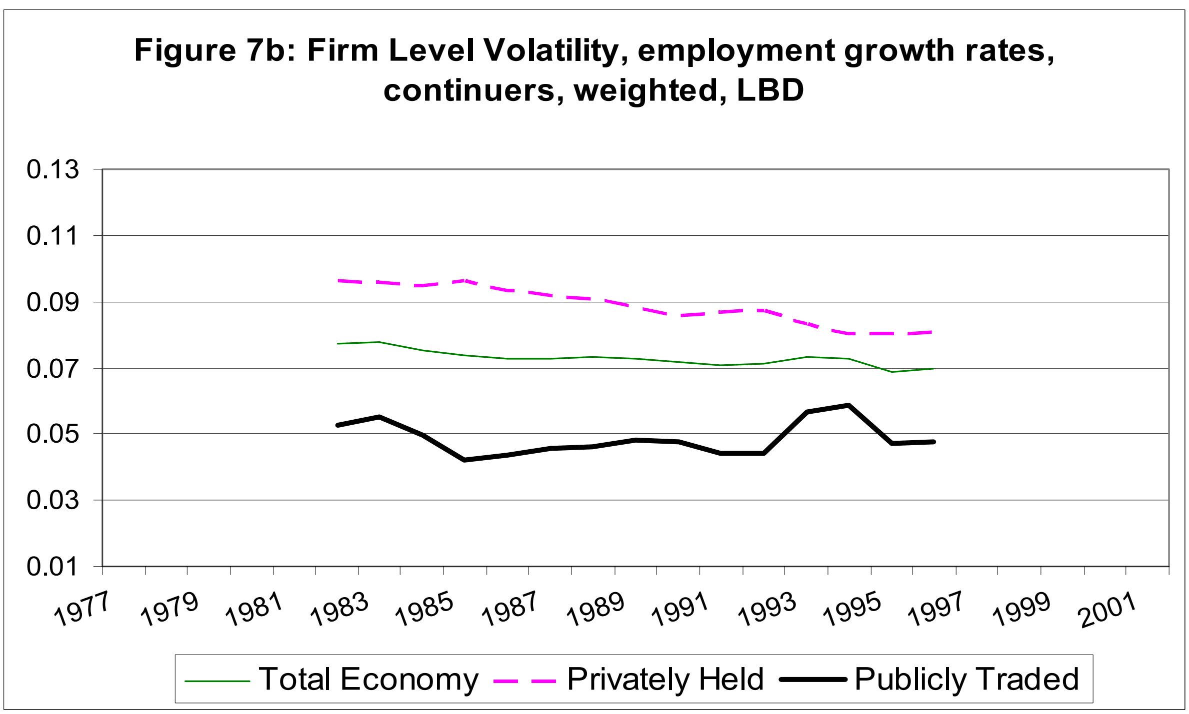
Figure 6: Modified Measure of Volatility in Firm Growth Rates, LBD Data



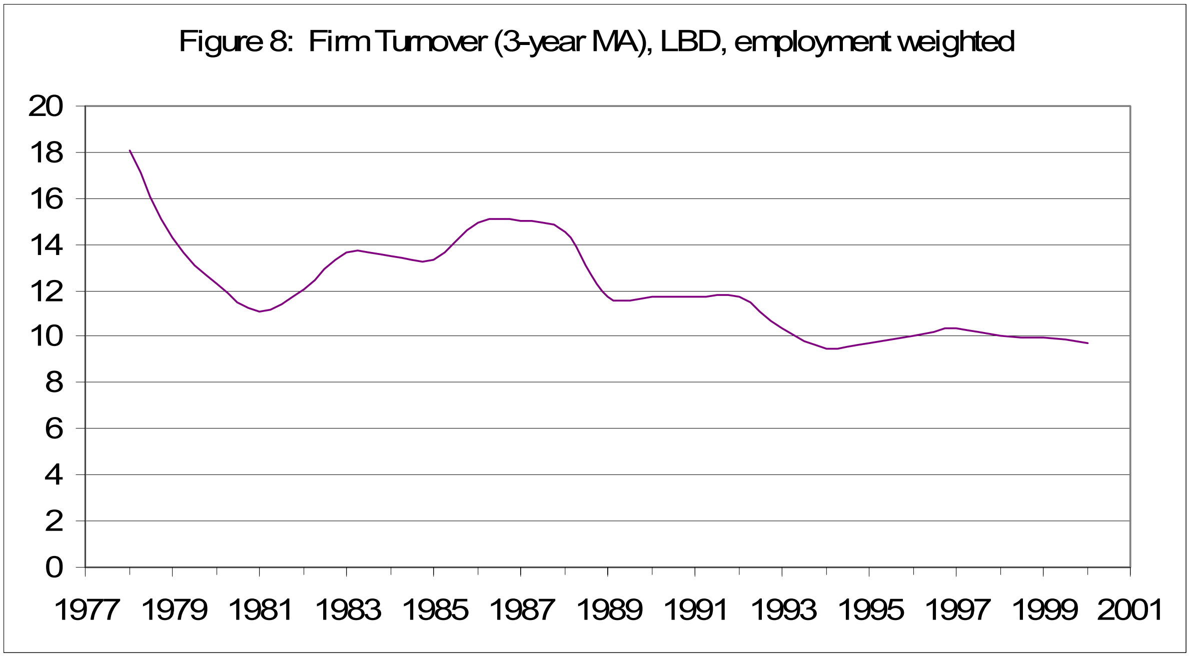
Source: Own calculations from LBD data.
Notes: Calculations include entry and exit and short-lived firms. Firm volatility calculated according to equation (6).

Figure 7: Volatility and Dispersion in Firm Growth Rates, Continuers Only, LBD Data



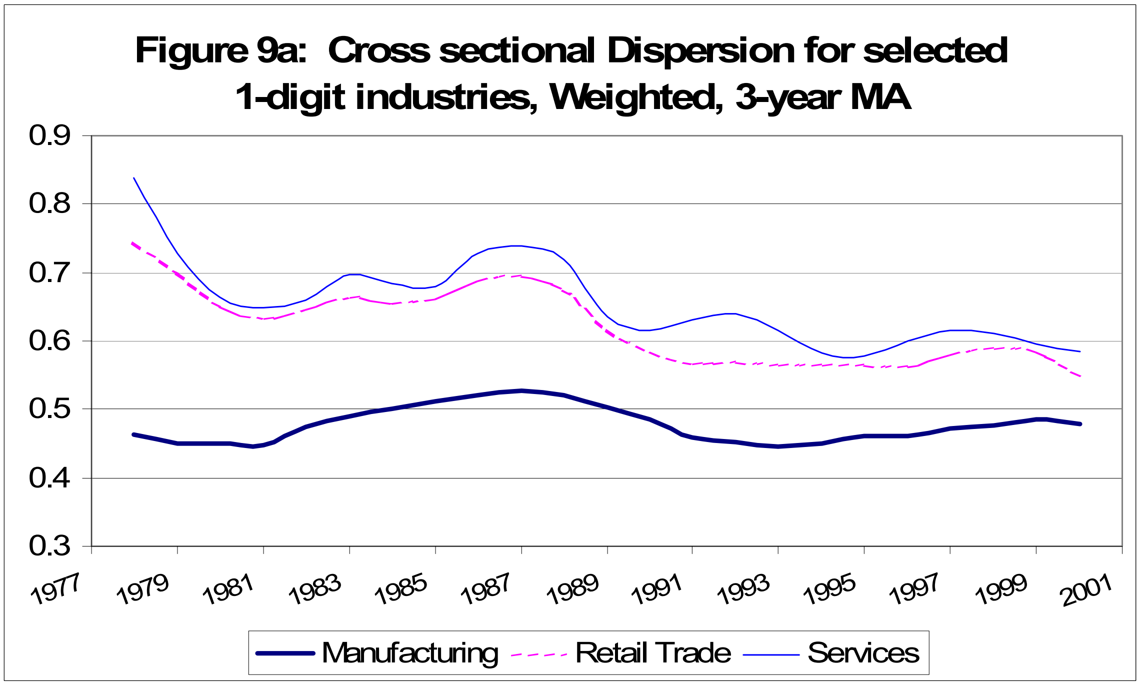


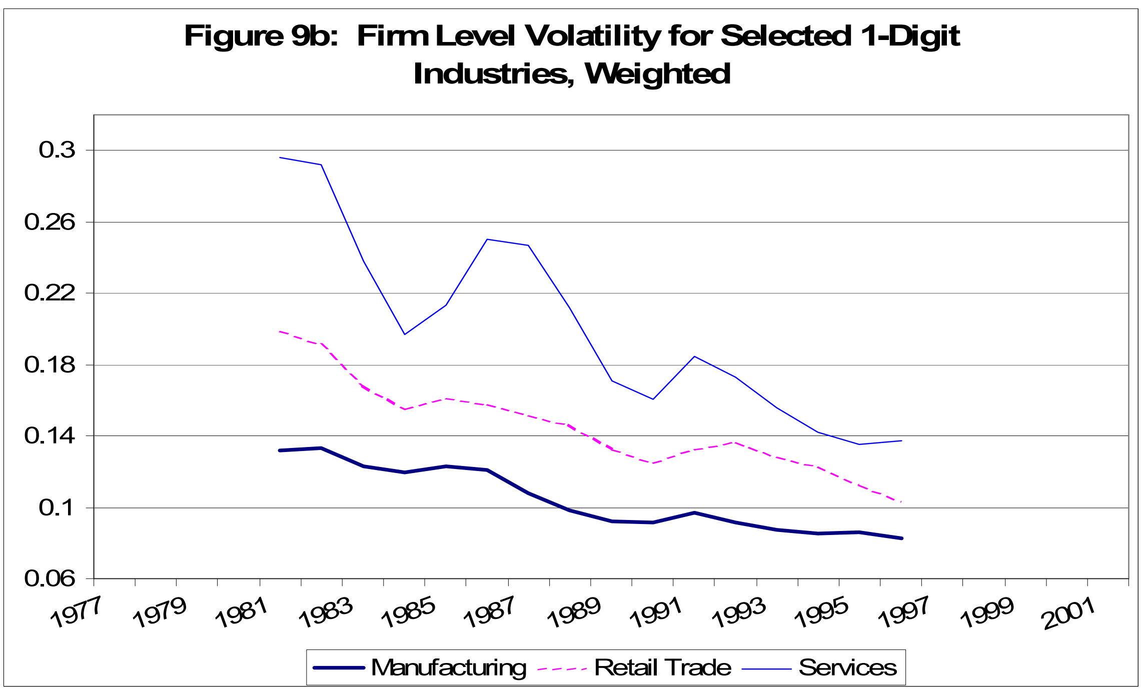
Source: Own calculations from LBD data. Note: Calculations exclude entry and exit.



Source: Own calculations from LBD data.

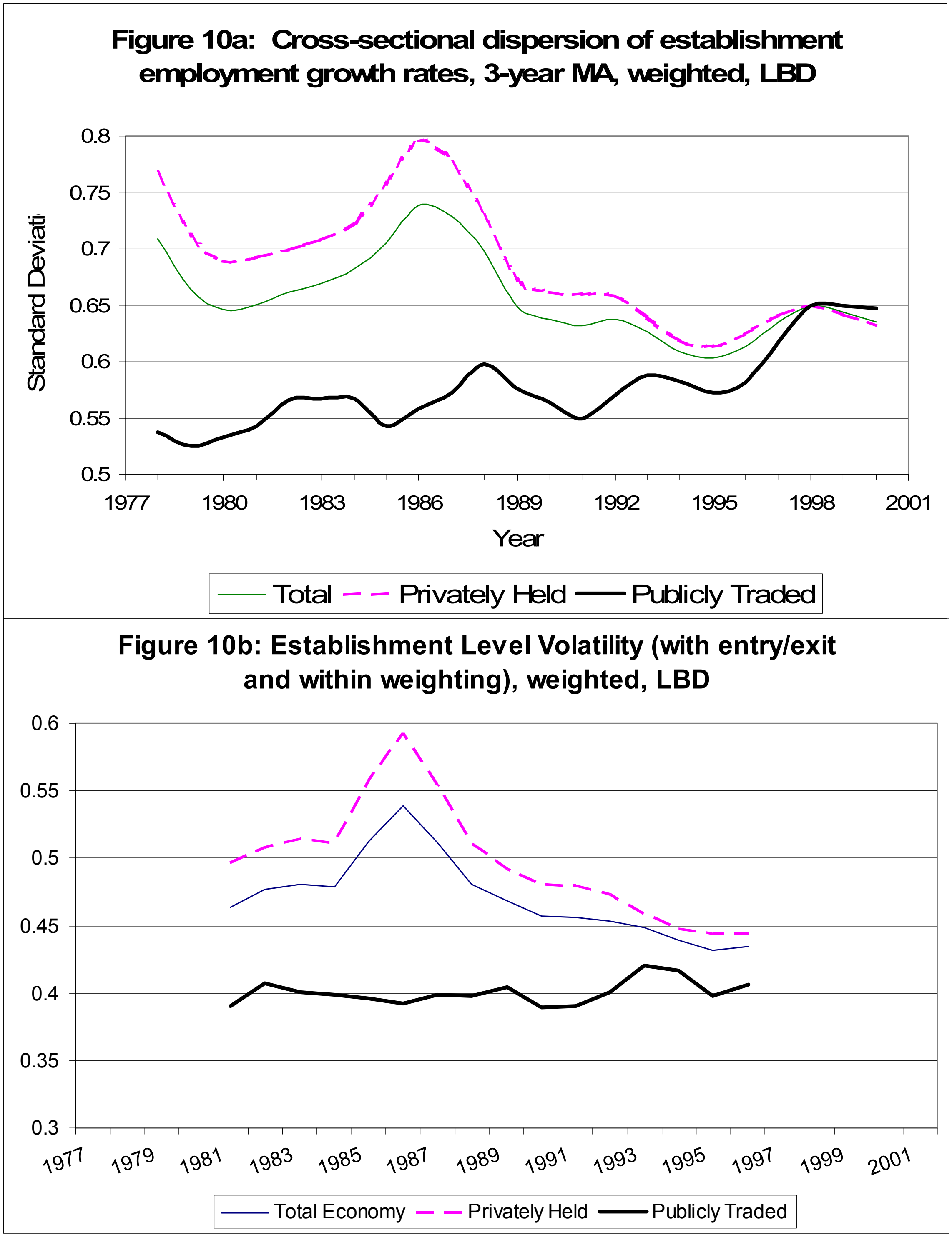
Figure 9: Volatility and Dispersion in Firm Growth Rates by Industry, LBD Data





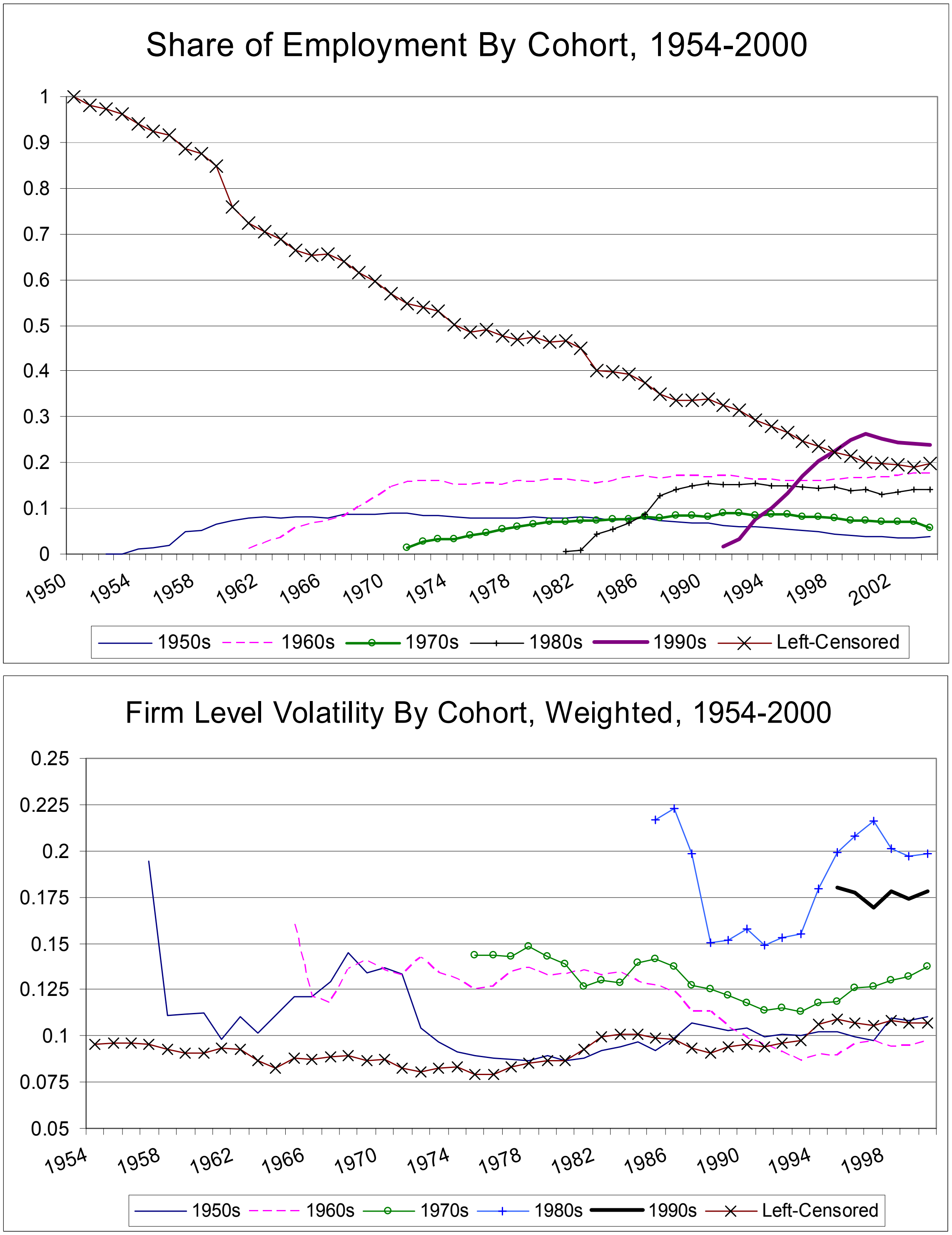
Source: Own calculations from LBD data.
Note: Calculations include entry and exit and short-lived firms. Firm volatility calculated according to equation (6).

Figure 10: Volatility and Dispersion in Establishment Growth Rates, Publicly Traded versus Privately Held Firms, LBD Data



Source: Own calculations from LBD data.
Notes: Calculations include entry and exit and short-lived establishments. Establishment volatility calculated according to equation (6).

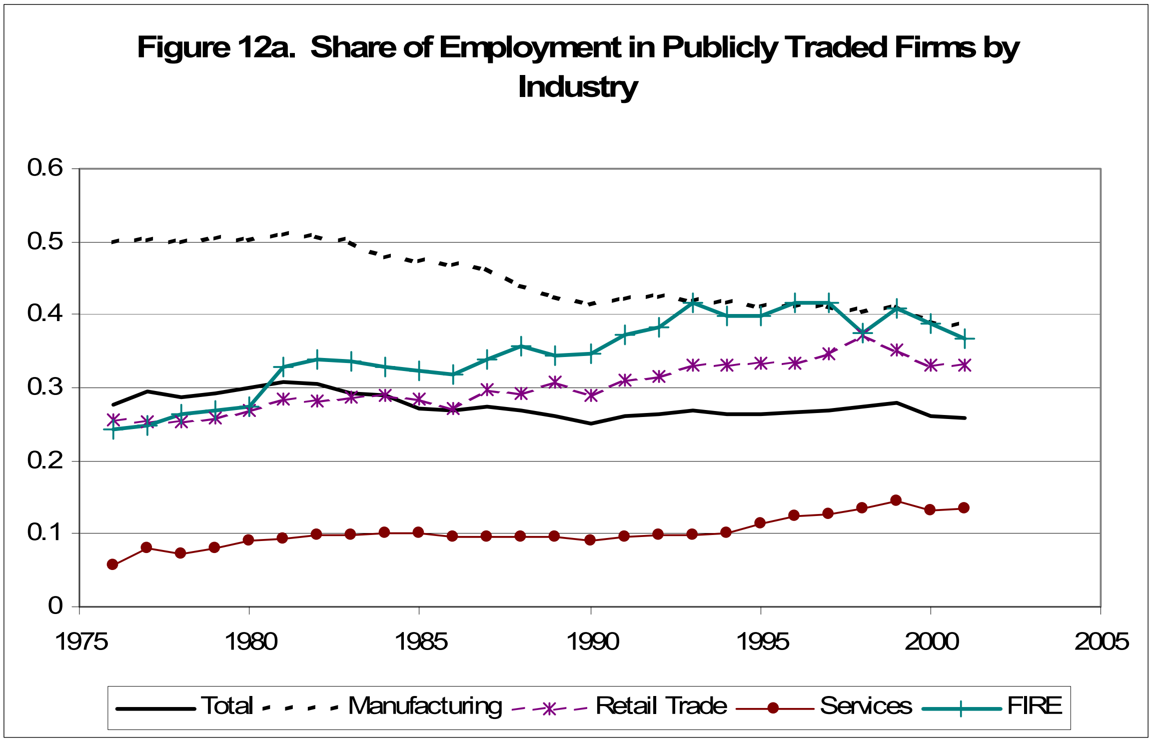
Figure 11: Employment Shares and Firm Volatility by Cohort for Publicly Traded Firms, COMPUSTAT data

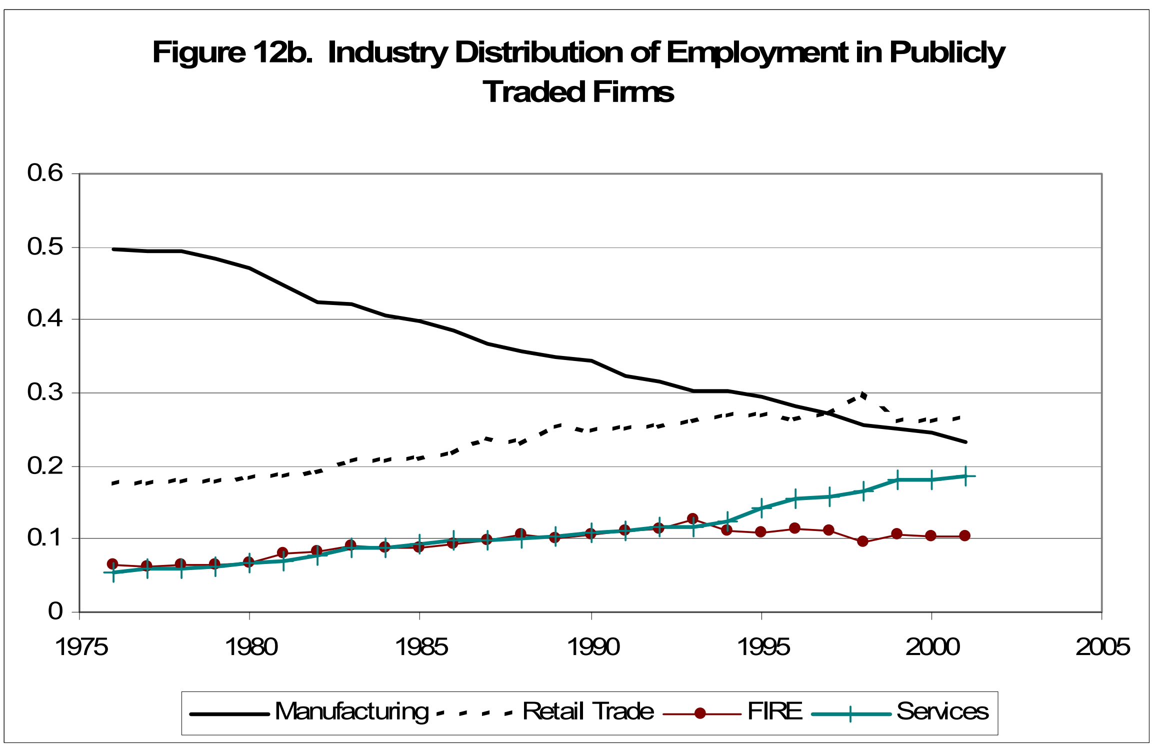


Source: Own calculations from COMPUSTAT data.

Notes: Calculations exclude entry and exit. Firm volatility calculated according to equation (5).

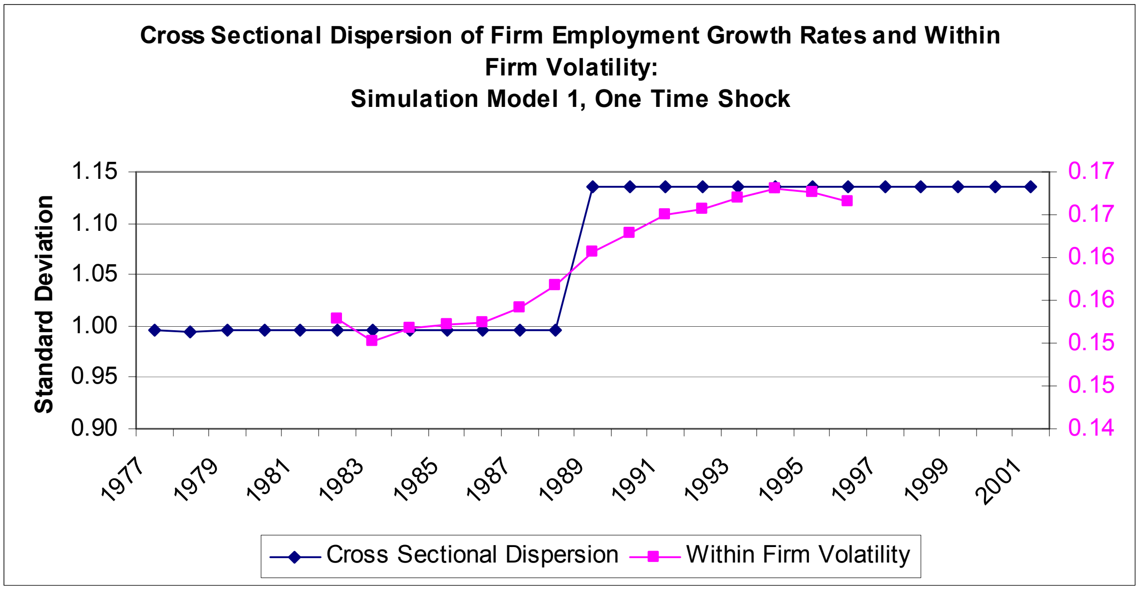
Figure 12: Employment Shares in Publicly Traded Firms by Industry, and Industry Distribution of Employment for Publicly Traded Firms, LBD Data





Source: Own calculations using LBD data.

Figure 13: Volatility and Dispersion in Business Growth Rates, Simulated Response to One-time Permanent Increase in Idiosyncratic Shock Variance



Source: Simulated data. Calculations include entry and exit.

Figure A1: Comparisons of Employment levels (logs) and Employment Growth Rates for LBD and COMPUSTAT matched firms (pooled 1994-2001)